The Welding Engineer

Reg. U. S. Pat. Office

Founded by L. B. Mackenzie, 1916

JANUARY, 1928 VOL. 13, No. 1

$3.00 per year in U. S. 608 S. Dearborn St., Chicago, Ill. $4.00 per year abroad

Prominent authorities in the welding industry will refer you to

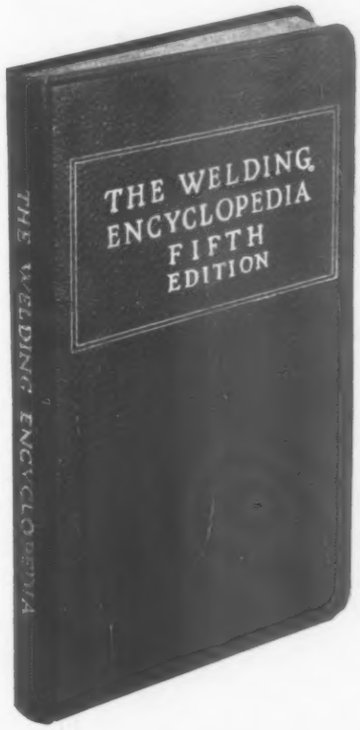
THE WELDING ENCYCLOPEDIA

FIFTH EDITION

for information on all methods of welding

Here are some of the subjects that are discussed by well known specialists.

Tank Welding
Pipe Welding
Structural Steel Welding
Railroad Welding
Rail Joint Welding
Preheating
Annealing
Cutting
Heat Treating
Testing Welds
Selecting Wire
Care of Equipment
Boiler Welding
Auto Welding
Welding Alloys
Machine Welding
Cost Finding



Ask Your Dealer For It

Orders sent direct will be shipped the day they are received. But you can get this book through your dealer if you desire. Progressive dealers and supply houses carry it in stock. They will gladly give you an opportunity to examine it, or we will send it on approval.

THIS book covers every phase of the art of Autogenous Welding as no other publication or group of publications has ever covered it. The Encyclopedia section of the text alone contains more information of value to welders than any book we know of. All this information is impartial. The idea is to present information that will enable the welder to understand his work better, no matter what the process is.

THE WELDING ENGINEER PUBLISHING COMPANY

608 S. DEARBORN ST. CHICAGO, ILLINOIS

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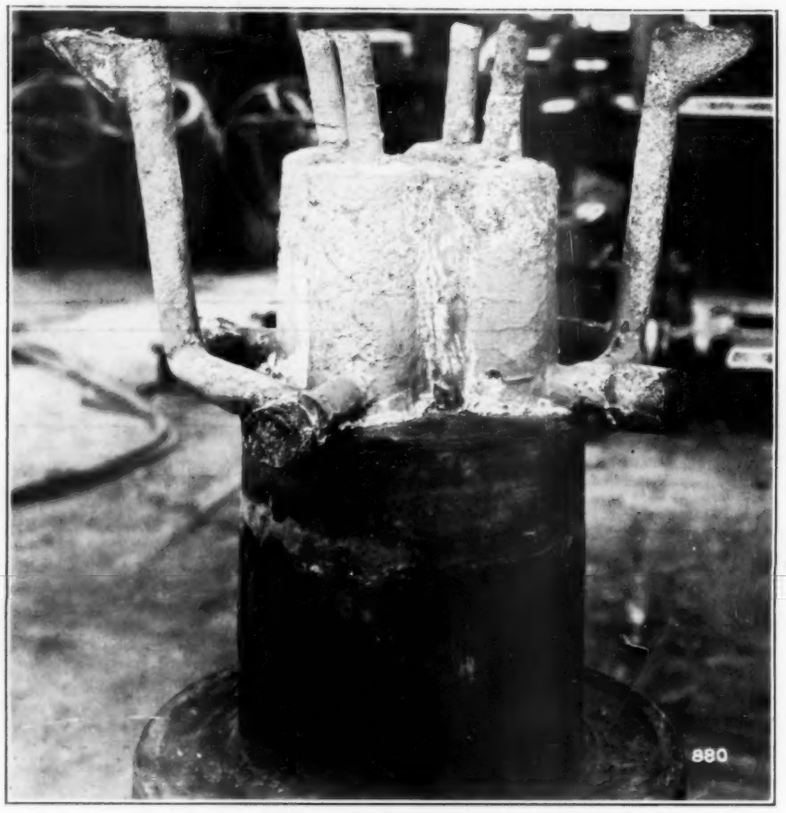
THERMIT

Railway
Steel Mill
Industrial
Marine



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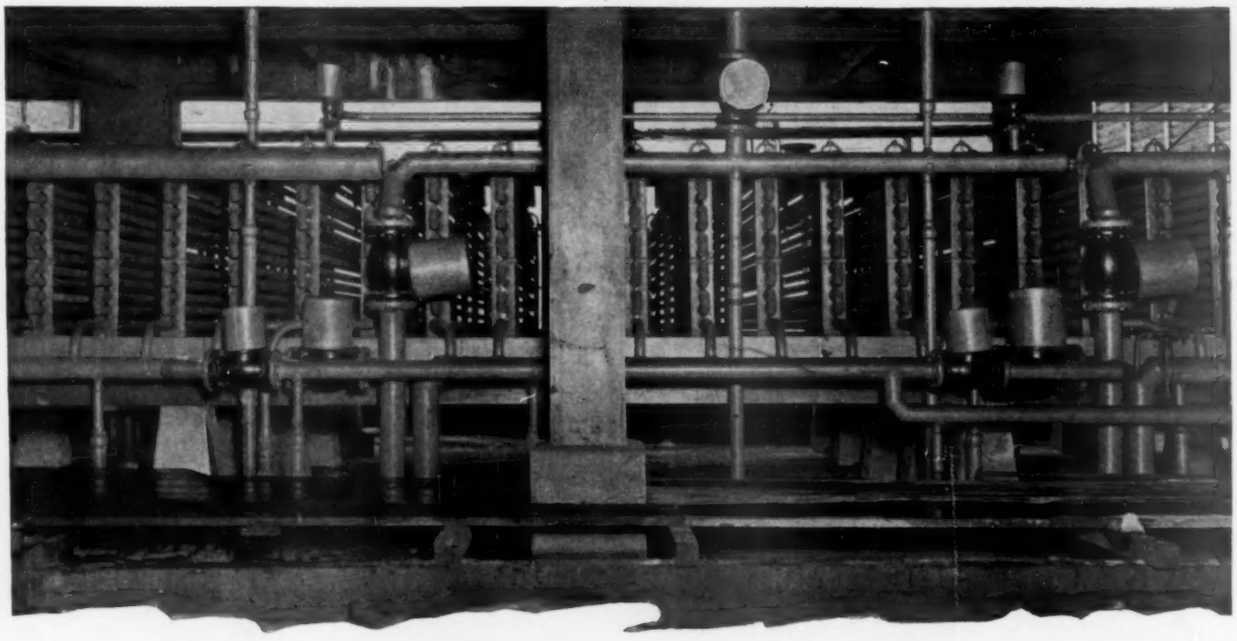

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The Welding Engineer

Founded by L. B. Mackenzie, 1916

Volume 13 | January, 1928 | Number 1

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In the Lead

A STUDY of the advertising appropriations of over a hundred typical industrial advertisers in all lines and in all parts of the country, including large, small and middle sized companies, shows not only that advertising is expected to be increased in the coming year but also that advertising in industrial papers will continue to hold its place as the most important avenue to increase sales of businesses of this type. Industrial publications have the largest percentage of the total appropriation, averaging over 43 percent of the total appropriation for the hundred firms who are using them. To the reader of the business paper this position of leadership, which its advertising pages hold, is very significant. It tells him that manufacturers generally consider these pages to be their most important methods of giving information concerning their products to possible buyers. A further inportant fact which has not been made the subject of investigation but which has become very apparent through following the meetings of associations, is that these advertisers have taken counsel directly from the buyers themselves to find out what kind of copy is most welcome to the reader. If they follow the advice which they have received the advertising sections of industrial publications should be more interesting and valuable than ever during 1928.

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Last Advertising forms close at 8:00 a. m. on the 12th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails. All copy should be in by the 12th of the month at the latest.

The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

Authorized Representatives

CLEVELAND—R. K. Randall, 2094 E. 19th St.
DENVER—A. G. Odell, Public Opportunity School.
GREAT BRITAIN—Capt. D. Richardson, 26 Winterbrook Road, Herne Hill, London.
AUSTRALIA AND NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand.
SOUTH AFRICA—J. W. Arnison, 35a Victoria Ave., Benoni, Transvaal, South Africa.

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Air Reduction Sales Co.
Commercial Acetylene Supply Co.
International Oxygen Co.
Prest-O-Lite Co.

ACETYLENE CYLINDERS
Keith Dunham Company
Pressed Steel Tank Co.

AIR LIQUEFACTION OXYGEN PRODUCING PLANTS
Keith Dunham Company
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Weldene Corporation

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Westinghouse Elec & Mfg. Co

APRONS (Asbestos)
Ideal Face Shield Co.

ASBESTOS INSULATED WIRE AND CABLE
Central Steel & Wire Co.

BLOW PIPES
See "Torches."

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Electric Arc Cutting & Welding Co.

BRAZING OUTFITS
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Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
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Alexander Milburn Co.
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Oxweld Acetylene Co.
Torchweld Equipment Co.
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Krembs & Co.
Mueller Brass Co.
Steel Sales Corp.

BUFFERS
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N. A. Strand & Co.

BUTT WELDERS
See "Electric Resistance Welders"

CABLE (Arc Welding)
Allan Mfg. & Welding Co.
Electric Arc Cutting & Welding Co.
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Lincoln Electric Co.
Quasi-Arc Weldtrode Co.
Una Welding and Bonding Co.
U. S. L. Battery Corp.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

CARBIDE
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National Carbide Co.
Shawinigan Products Corp.
Union Carbide Sales Co.

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Electric Arc Cutting & Welding Co.
Harris Calorific Co.
National Carbon Co.
Oxweld Acetylene Co.

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Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
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Modern Engineering Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.

CAST IRON SOLDER
Crown Aluminum Solder Co.
Weldene Corporation

CONSULTING ENGINEER
B. F. Hollinger
R. E. Kinkead
R. C. Pierce

CONTRACT WELDERS
S. O. S. Welding Corp.

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Lincoln Electric Co.
National Carbon Co.
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Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

CYLINDERS (Acetylene)
Keith Dunham Company
Pressed Steel Tank Co.

CYLINDERS (Oxygen, Hydrogen)
Wm. Wharton, Jr. Co.

DRILLS, PORTABLE ELECTRIC
Stoody Company
N. A. Strand & Co.

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E. A. Lundy Co.
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ELECTRIC RESISTANCE WELDERS
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Goodman Electric Machinery Co.
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See "Cutting Electrodes"

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Central Steel & Wire Co.
Chicago Steel & Wire Co.
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Roebling, John A., Sons Co.
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Steel Sales Corp.
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Welding Service Co.
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Wilson Welder & Metals Co.

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Waters Arc Welding Corp.
Welding Service Co.
Westinghouse Elec. & Mfg. Co.
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ELECTRODE TIPS (Resistance Welding)
Elkon Works, Inc.

ELECTROLYTIC OXYGEN AND HYDROGEN GENERATING EQUIPMENT
International Oxygen Co.

FACE SHIELDS (Arc Welding)
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Chicago Eye Shield Co.
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General Electric Co.
Gibb Welding Machines Co.
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Ideal Face Shield Co.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
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U. S. L. Battery Corp.
Waters Arc Welding Corp.
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Williams & Co.
Wilson Welder & Metals Co.
Wilson Goggles, Inc.

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FLUE WELDERS (Electric)
General Electric Co.

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Metal & Thermit Corp.
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Krembs & Co.
Modern Engineering Co.
Oxweld Acetylene Co.
St. Paul Welding & Mfg. Co.
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Harris-Calorific Co.
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Above: part of a steel structure which was welded with Wilson Grade No. 17 bare wire. *At left:* an example of the arc welding done on the large steel girders.

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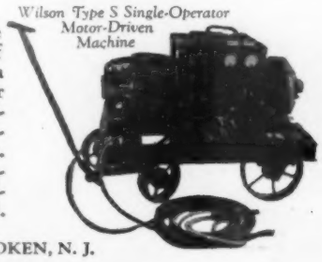
Wilson Type S Single-Operator Motor-Driven Machine



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WILSON

WELDING MACHINES AND WELDING WIRE

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Modern Engineering Co.
Oxweld Acetylene Co.

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Weldit Acetylene Co.

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Williams & Co.

SEAM WELDERS
See "Electric Resistance Welders"

SPOT WELDERS
See "Electric Resistance Welders"

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International Oxygen Co.
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Oxweld Acetylene Co.
Torchweld Equipment Co.

THERMIT WELDING
Metal & Thermit Corp.

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Joseph Dixon Crucible Co.
Modern Engineering Co.
National Carbon Co.

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SWEDOX Service now available from three warehouses

We have just finished the equipment of our third warehouse and branch office at Dayton, Ohio, from which we are prepared to make shipment the same day we receive your order for

SWEDOX

WELDING RODS, WIRES and ELECTRODES

These wires have been selected for you by means of research which started at the very beginning of fusion welding and has kept pace with every new development in succeeding years. There is a rod or wire in the SWEDOX line for every type of welding job; and you can safely follow our recommendation in the choice of the correct material for your work.

You can make your own proof of the quality of SWEDOX. Just send for a sample to try on your work.

WELDING CARBONS

We have recently become distributors of the products of

NATIONAL CARBON CO., INC.
Cleveland, Ohio

Our stock of National Welding Carbon Products is complete and includes Carbon Plates, Rods, Paste, Welding Electrodes and Graphite Electrodes.

Central Steel & Wire Company

CHICAGO, ILL.
4545 S. Western Blvd.
Lafayette 8500

DAYTON, OHIO
East Monument Ave.
Extended
East 150

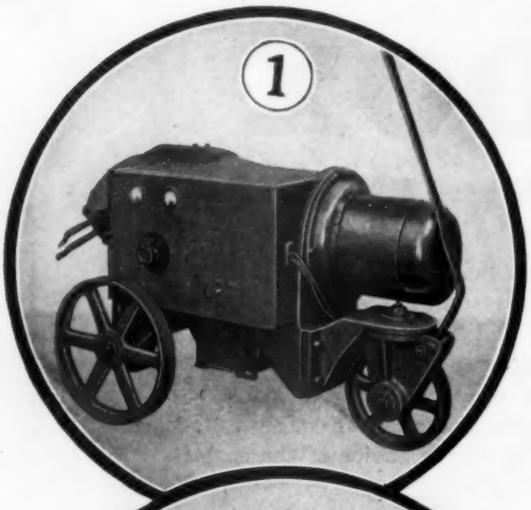
DETROIT, MICH.
5001 Bellevue Ave.
Lincoln 6780

ACCESSORIES FOR WELDERS

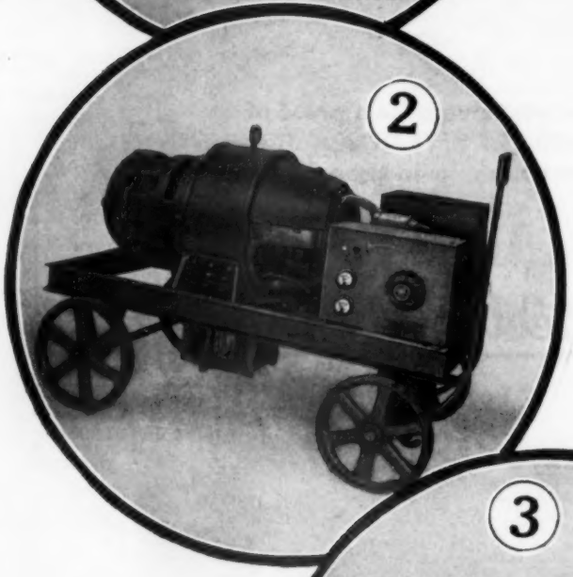
A complete stock of all welding accessories, including goggles, helmets, shields, gloves, electrode holders, lenses, etc., is carried in each of our three warehouses. Include whatever accessories you need in your next order.

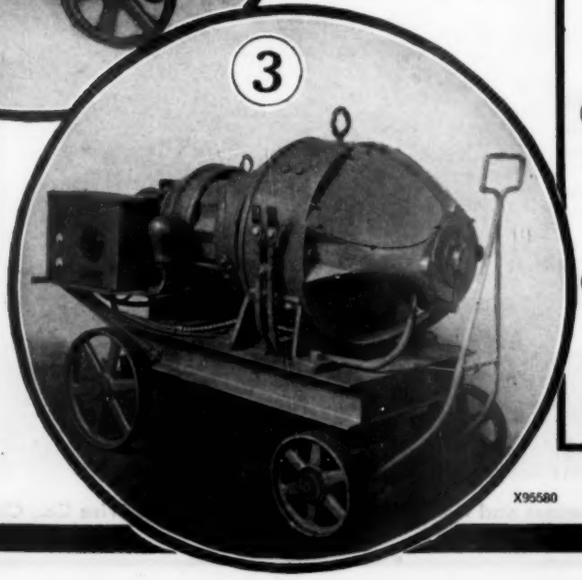
Main Warehouses and General Offices, Central Steel & Wire Co., Chicago.

Now—



Three Master Welders





X95580

200 Ampere

(1) This unit will operate over a wide range from 60 to 300 amperes which is the range ordinarily required in general welding service. It has a rating of 200 amperes for one hour, high continuous capacity.

300 Ampere

(2) Has a welding range of from 75 to 400 amperes. This increased capacity enables operators to handle heavy work in addition to average welding work, and is recommended for automatic service. It has a definite rating of 300 amperes for one hour, high continuous capacity.

400 Ampere

(3) Designed and Constructed for extra heavy work in addition to average welding work, and for automatic service where high current and speed is desired. This unit has a welding range of from 100 to 500 amperes and has a definite rating of 400 amperes for one hour, high continuous capacity.

A Distinct Type
of Single Operator Set
for
Each Class of Work

THE speed in operation, the strength and uniformity of welds, the high efficiency over the entire operating range, "pep" and stability, and the low maintenance costs that characterized Westinghouse Welding Sets in the past, are embodied in these three machines—plus new mechanical features which the rapidly increasing use of electric arc welding demands.

So now there is a complete line of welders available—distinct types of single operator sets for each class of work—ranging in capacity from 200 to 400 amperes.

These sets represent the latest development in welding machinery. The entire range of each machine is obtained by merely turning a single rheostat handle. They are all equipped with Linestart Motor and Linestarter—a simple and economical combination. Just push the button and the Linestarter functions, the motor starts and the machine is in operation.

The generator instantly responds to any change of voltage in the arc. The design of the Westinghouse Welding generator assures a fast, dependable machine—one that assists the operator to do more and better work.

Additional information can be obtained from our nearest district office.

Westinghouse Electric & Manufacturing Company
East Pittsburgh Pennsylvania
Sales Offices in All Principal Cities of
the United States and Foreign Countries

Westinghouse

X95581

Easy *and* Economical to Use *and* Dependable *in* Results

In these days of "quick service", it is important to know that your Welding Bronze is 100% RIGHT.

Mueller Improved Welding Bronze Rod is right as right can be. It is made only from pure, virgin metals, alloyed in electric furnaces. It is uniform in quality and free from impurities.

Last, but not least, the rods are all extruded or forced through dies under 2,000 tons hydraulic pressure to insure minimum porosity, less sputtering, and greater tensile strength.

Made in ⅛, $\frac{3}{16}$ and ¼-inch sizes, in 36-inch lengths. Also in other sizes or lengths and in coils. Packed in 100, 250 or 300-lb. boxes. Each rod is stamped "Mueller Welding Bronze Rod" for your protection. Sold by leading welding material distributors.

Write for Liberal Free Sample

MUELLER BRASS CO.
Port Huron, Michigan
Detroit District

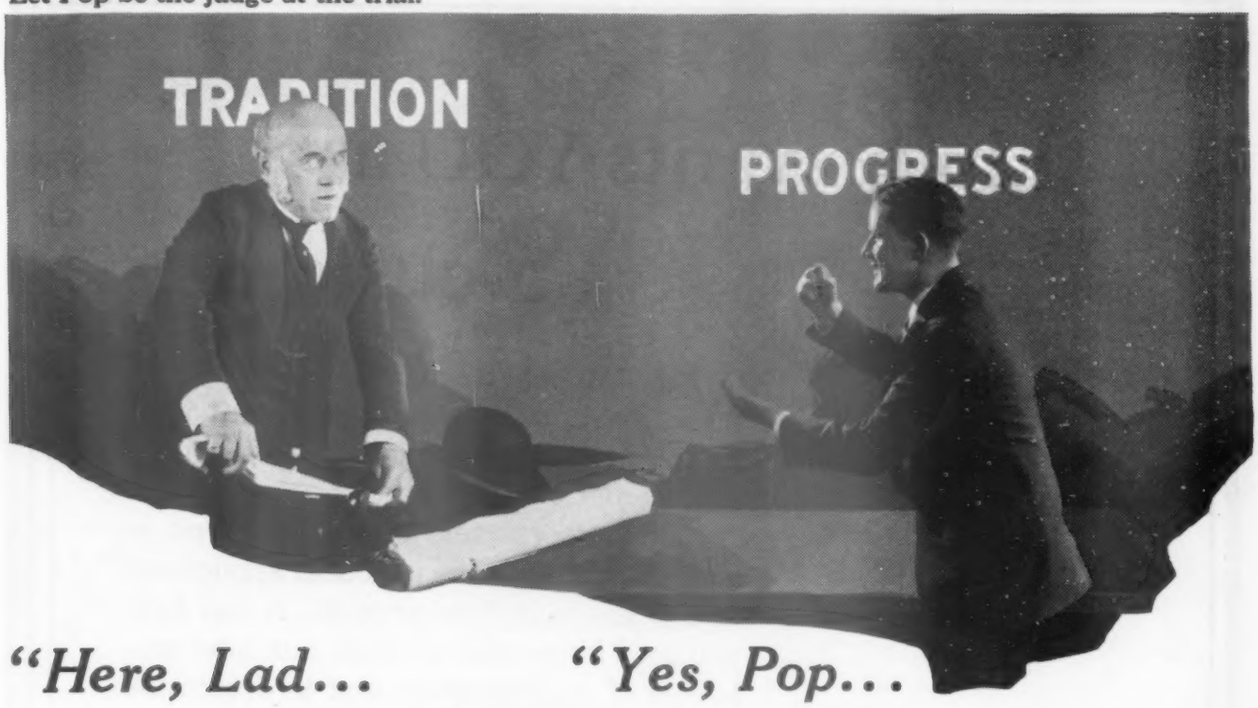
Mueller
Makes
Red Tip Brass Rod
Relleum Brass Forgings
Niag Nickel Silver Rod and Forgings
Tuf-Stuf Rod and Forgings
(*Corrosion Resisting Metal*)
Sandcraft Brass Castings
Brass Screw Machine Parts
Mueller Blue Tip Bronze Rod
Brass and Copper Seamless Tubing
Mueller Blue Tip Bronze Welding Rod

Mueller WELDING BRONZE ROD

Mueller Brass

THREE GENERATIONS OF BRASS MAKING

Let Pop be the judge at the trial.



"Here, Lad...

you tell me that the fellows in the shop don't like the way the welding rod I buy them is packed and wrapped.

You know, Lad, it's hard to judge a man by his clothes."

"Yes, Pop...

and today it's absolutely impossible to judge a woman that way.

But you CAN judge a welding rod.

Just let me send for some of that Lincoln 'Stable-Arc' BLUE welding rod (non-splashing).

It's judged by it's clothes:

A nice BLUE coat.

And the better work it makes the men do proves that it has a good influence on them. Then it's packed (not wrapped) in steel containers.

The rod gets to our men in the same condition that it left the Lincoln men.

The package is neat—but not gaudy.

The rod does a job that's neat but not splashy.

And no Mid-Victorian maiden aunt was ever better protected from the elements."

A new text book on Arc Welding (Price $1.50) will be sent on approval for five days to any executive requesting it.

Book size, 6"x9"—total pages, 160—number of illustrations, 200—Charts, 62—Divisions, 8.

The Lincoln Electric Co., Dept. No. 27-1, Cleveland, Ohio

W-30

"Stable Arc"

LINCOLN WELDER

Linde wants YOU as a customer

WHETHER you are a large or small user of oxygen, whether your plant is in Maine or California, Linde wants you for a customer.

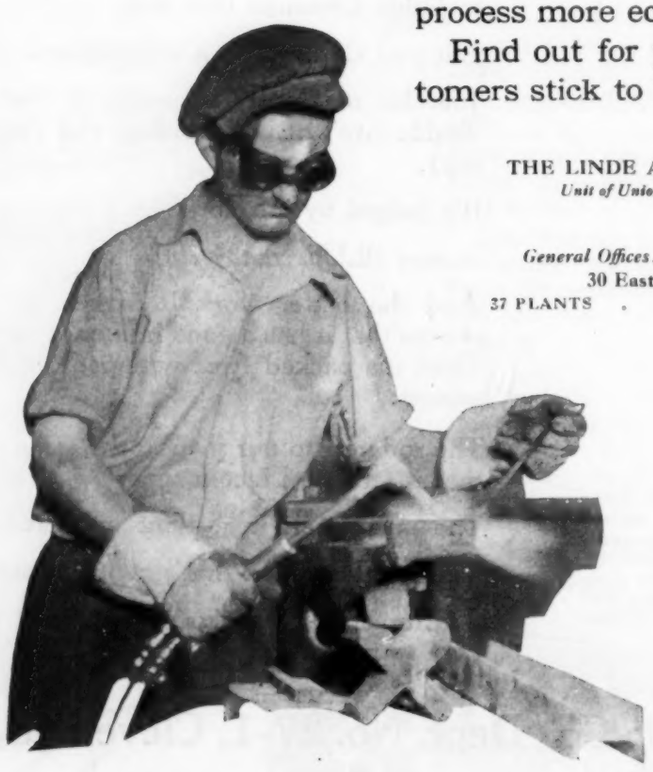
Linde process service can help you as a small user with the practical application of the oxy-acetylene process. It can help you as a large user to work out new processes of manufacture and to determine just how you can use the oxy-acetylene process more economically.

Find out for yourself why Linde customers stick to Linde.

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation

UCC

General Offices: Carbide and Carbon Building
30 East 42d Street, New York
37 PLANTS . . . . . 107 WAREHOUSES



LINDE OXYGEN

Portability

Repair jobs do not respect convenience. On one side of the plant there is a steam leak that must be stopped quickly by oxwelding. Or, a machine breaks on the other side of the plant. Again a hurry call for the welder. Time after time oxwelding equipment must be transported with speed.

Then the convenience of moving a cylinder of Prest-O-Lite dissolved acetylene becomes apparent. The WK cylinder contains about 270 cubic feet of gas and weighs much less than even the smallest welding type generator; the WC size (100 cu. ft. capacity) offers a still greater factor of portability. That is why cylinders are always used where portability is essential.

THE PREST-O-LITE COMPANY, INC.
Unit of Union Carbide and Carbon Corporation
UCC
General Offices: Carbide and Carbon Bldg., 30 East 42d St., New York
31 Plants — 101 Warehouses

Prest-O-Lite
DISSOLVED ACETYLENE

Oxweld's Banner Year

1927 was the biggest year in Oxweld's history and Oxweld is proud of it. This means that the reputation established by Oxweld equipment during the last fifteen years is substantial.

And in 1928 more people than ever before will buy Oxweld injector blowpipes, Oxweld regulators, Oxweld welding rods and fluxes.

These increased sales, demand increased service. Oxweld is to give increased service to greater numbers than ever before—service that will help them use Oxweld equipment efficiently and economically.

OXWELD ACETYLENE COMPANY

UCC

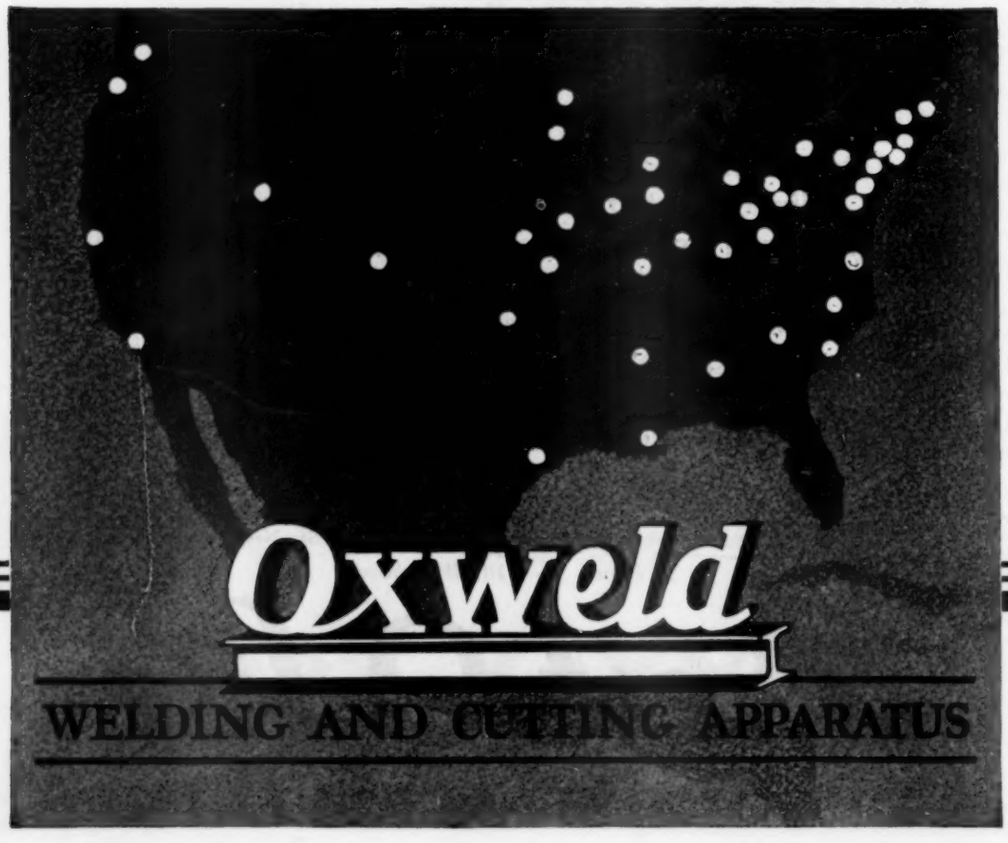
Unit of Union Carbide and Carbon Corporation

CHICAGO
3642 Jasper Place

LONG ISLAND CITY, N.Y.
Thompson Ave. and Orton Street

SAN FRANCISCO
8th and Brannon Sts.

STOCKS IN 39 CITIES



You can get the best of arc welding performance from the

OWEN
INDUCTION ARC WELDER

THE OWEN INDUCTION ARC WELDER
Size, 13x27x21 inches. Weight, 190 pounds.
Approved and Accepted by National Board of Underwriters

ELIMINATES EVERY INCONVENIENCE

No motor—No generator.
No transformer.
No "power house" equipment.
No rheostat.
No exciter—No stabilizer.
No auxiliary equipment.
No unnecessary attachments.
No upkeep—No repairs.
No excess weight.
No water to leak or freeze.
No "messy" oil—No fan.
No overheating, hence
No artificial cooling device.
No resistance—No reactance.
No waste—No loss.
No preheating.
No loss of time.
No "dope" used.
No guess work.
No moving parts to wear out.
Nothing to get out of order.
Nothing to adjust.
FOOL PROOF.

MEETS EVERY WELDING REQUIREMENT

It gives perfect penetration. No "plastering on top."

The arc is easily struck, manipulated and maintained.

It compels a close arc, which promotes speed and penetration, and avoids oxidization and crystallization.

The undesirable long arc ("cutting" arc) can't be maintained.

Operation simple—The arc is controlled by a single handle.

Owen Induction welds are strong and ductile, easily and readily filed, machined, drilled or threaded.

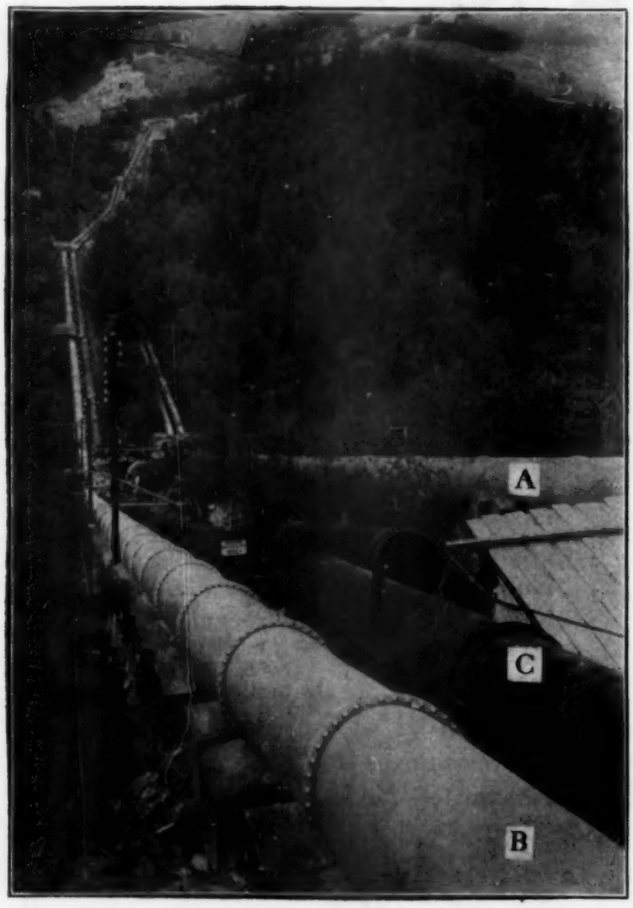
The most economical arc welder built. Uses only one-fourth the power required by most D. C. welders, and only one-half the power required by all other A. C. welders.

Built for a lifetime of satisfactory service

OWEN ELECTRIC WELDER CO.
General Distributors

704 W. O. W. Building **Omaha, Nebraska**

Progress in Pressure Main Construction



Hydraulic Pressure Main of 380 lbs. per sq. in.
Diameter 48"

QUASI-ARC ELECTRODES

when applied according to Quasi-Arc methods of design are rapidly replacing former ways of joining plates and shapes in steel construction. This feature is brought about mainly by the correct composition of Quasi-Arc Electrodes which are so manufactured to give critical metallurgical conditions thus allowing low cost and highly efficient and uniform welding production.

←*A* FIRST MAIN: RIVETED

THIRD MAIN:
←*C* *Quasi-Arc*-WELDED

←*B* SECOND MAIN: WATER GAS WELDED

QUASI-ARC PRODUCTS

Quasi-Arc Patent Electrodes are supplied ready for use in standard lengths of 18 inches, and with cores of various diameters, according to size and nature of work for which they are required, as follows:—

Mild Steel Electrodes Suitable for general welding of Iron or Mild Steel, Structural Steel Work, Bridge Reinforcement, Tanks, Ship Construction, etc.

Overhead Electrodes Suitable for any overhead or vertical welding.

Special Boiler Electrodes Suitable for boiler welding and work to be subjected to stresses at high temperatures and forgings.

Electrodes for Cast Iron Suitable for the repair of iron castings.

Carbon Steel Electrode Suitable for reinforcing worn parts of machinery, building up teeth of steel gear wheels, reinforcing steel wobbler ends for rolling mills, grooves of ropeway pulleys, rail treads, etc.

Manganese Steel Electrodes Suitable for reinforcing or building up Manganese Steel crusher jaws, dredger bucket lips, frogs and crossings, etc.

Vanadium Steel Electrodes Suitable for building up gear wheels, crank shafts, axles, etc., which may require case-hardening.

Stainless Steel Electrodes Suitable for welding Stainless Steel.

QUASI-ARC INCORPORATED

Manufacturers of and Consultants in reference to the Application of Quasi-Arc Electrodes and Welding Equipments.

11 West 42nd Street, New York, N. Y.

Photograph from the Whitlock Coil Pipe Company, Hartford, Conn. showing a welded drip header and an all-welded tank in background. Type "F" G-E Welding Electrode was used.

"All welded and not a leak!"

This laconic report of the Welding Superintendent applies to the drip header above. In it are twenty nipples—all welded. It was given a thorough test but not one leak was found.

It is typical of the excellent combination which a good welder and General Electric Welding Electrode make.

Type "F" is a bare wire treated by a special General Electric process to obtain a stable, concentrated arc. It is used for general welding of steel.

Type "B" is best for automatic welding. The concentrated arc confined by encasing the flux around the core in a sheath, gives remarkable penetration for higher speed welding.

Type "A" is recommended for cast iron.

Special distributors for G-E Welding Electrodes located throughout the country are equipped to give you prompt service. Get in touch with the G-E Welding Electrode Distributor near you or write to the Merchandise Department, General Electric Company, Bridgeport, Connecticut.

In absolute reliability of operation and over-all efficiency, G-E Arc Welders are unequalled. They are available in all sizes, all types—for either hand or automatic operation—for one or more operators.

550-200

GENERAL ELECTRIC

MERCHANDISE DEPARTMENT, BRIDGEPORT, CONNECTICUT

For all welding operations—

National Welding Carbon Products

Blocks . . .

Rods . . . . .

Paste . . . . . .

Flour . . . . . .

Electrodes . . .

WHETHER you do gas or arc welding, National Welding Carbon Products are at your service. Not only are they available for use in making moulds, cores and dams, but as electrodes they are playing a vital part in the development of the arc processes. Using modern methods and materials it is now possible to weld with a minimum of heating of adjacent parts, and produce welds that are not only stronger than riveted joints, but actually stronger than the shapes themselves.

Our advice has been of great assistance to manufacturers, contractors, and engineers. May we help you realize the economies of modern welding?

NATIONAL CARBON CO., INC.
New York UCC San Francisco
Unit of Union Carbide and Carbon Corporation

Emergency Service Plants
CHICAGO, ILL. PITTSBURGH, PA. NEW YORK, N. Y. BIRMINGHAM, ALA.

"Runnin' Wild"—an attractive bronze by Frederick Willard Potter, famous Western sculptor.

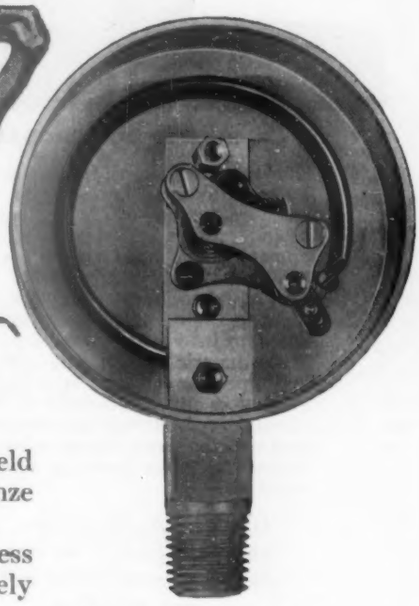
Enduring Bronze

Because the principal working member of every Natweld Gauge—the Bourdon spring—is made of enduring bronze and is thus not subject to rust or corrosion—

Because that bronze spring is treated by a special process that causes it to remain accurately flexible over an extremely long life-period—

Natweld Gauges are reliable under the most severe conditions of service.

A decade of successful performance inspires confidence in such a product. And the user need not pay a premium for that confidence, for huge production, plus volume sales have made possible very reasonable prices.



The Moto-Meter Co. of Can. Ltd., Hamilton, Ontario
Chicago Office: 820 Tower Ct.
Represented in Illinois, Indiana, Wisconsin, Minnesota and Missouri
By Joseph Halla, Chicago, Illinois

The National Gauge and Equipment Co.
La Crosse, Wisconsin
A Division of the MotoMeter Co., Long Island City, N. Y.

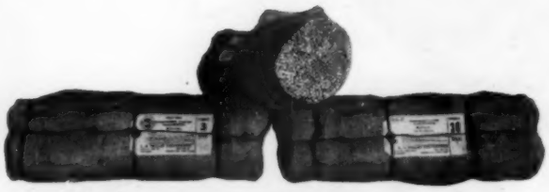
NATWELD

GAUGES

PRACTICAL DESIGN is your assurance of satisfaction with

HOLLUP

Welding Products



HOLLUP ELECTRODES

The manufacture of Hollup electrodes by our Chicago plant is under the personal direction of Mr. Charles H. Hollup, whose experiments and development work have covered a period of about twenty years. Every precaution is taken in the selection of material in the manufacture of the various wires to insure the protection of electrode material which will make welding operation more economical by making it easier. Records of the performance of Hollup electrodes show that welding costs can be substantially reduced in many cases by using these materials.

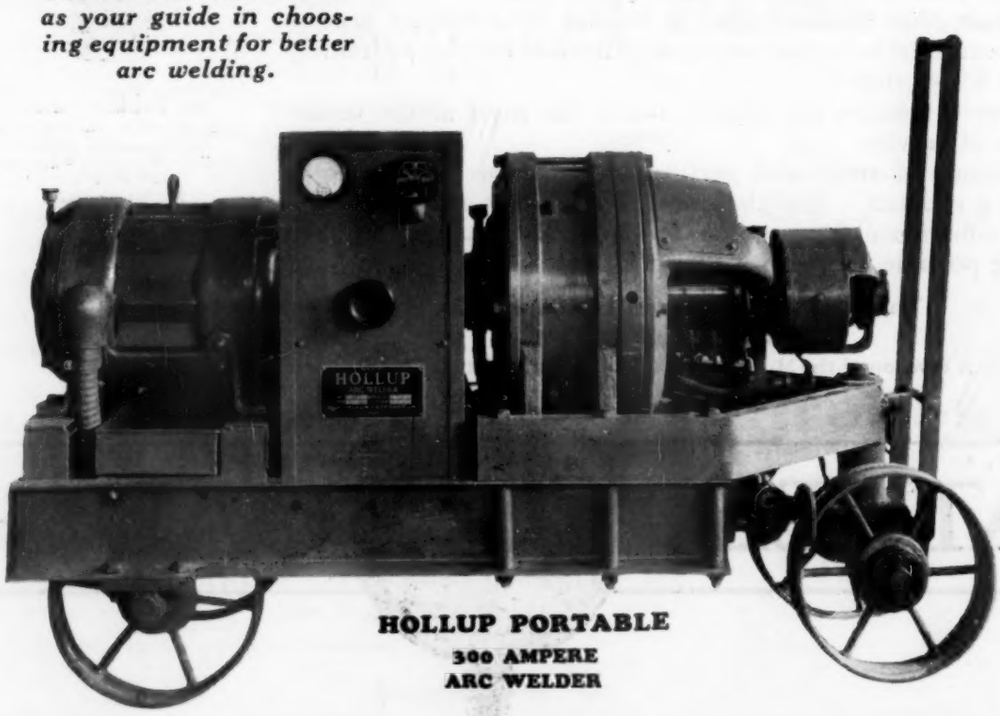
Use our Bulletin No. 130 as your guide in choosing equipment for better arc welding.

THE story of Hollup products is a story of arc welding economies developed under conditions which require the finest kind of welding. Ten or fifteen years ago the value of arc welding was not accepted by everybody. A few men, however, were able to develop equipment and welding materials which gave results that were considered amazing.

Engineers from this small group are responsible for the perfection and performance of Hollup welding machines and welding wire. They have solved for you the problem of getting the highest quality of welding and at the same time obtaining the economies which are necessary in production.

Every Hollup product must prove itself thoroughly practical in design before it is offered for your use.

C. H. HOLLUP CORPORATION
3333 W. 48th PLACE CHICAGO, ILL.



HOLLUP PORTABLE
300 AMPERE
ARC WELDER

EDITORIAL

Business Papers Forecast Good Year

THAT business generally is in a sound condition and that there are rather definite indications of increase in several lines, is the concensus of one hundred editors of trade, industrial and professional journals in answer to a questionnaire sent to them by the National Conference of Business Paper Editors and the Associated Business Papers. The accepted indexes of trade conditions for 1927 showed either slight increases or slight decreases, making the general average approximately the same as the previous year. Editors of papers report increased pressure to reduce production and selling costs, higher specialization in machinery, replacement of obsolete machinery, aggressive market binding, reduction in size and a tentative development of jobbing areas. Likewise, a genuine desire to keep wages at the present level in all the basis industries and manufacturers and merchants are seeking to continue with narrow profit margins without reducing wages or raising prices. The general construction is reported lower due to reduction of residential buildings with industrial construction and certain classes of public works buildings very much increased. Heavy construction is 11 per cent higher, industrial construction is 2½ per cent higher, electric light and power plant construction about 5 per cent over 1926 with estimated additional 5 per cent increase in 1928. During 1927 a million dollars a day was spent for new hospital buildings and the rate for next year is said to be higher. Although there was a general shrinkage in aggregate pay rolls in 1927, the hourly rate for workers changed little and there are no important indications of downward wage revisions during the coming year. Prices throughout 1927 are quoted as slightly lower and the margin of profit less but the outlook for 1928 is generally considered favorable with some slight price increases. On the whole the outlook is decidedly favorable and encouraging and the picture is presented by a group which, all told, has a very detailed and accurate knowledge of current business conditions in this country.

Aviation Is Making Us "Weight-Minded"

OTHER industries are beginning to profit by the experience and knowledge gained in the aeronautical field. One example of this is in the design and fabricating of structures required to carry a varying load and to withstand vibration, without adding undue weight or bulk to the structure. The old idea has been to build a machine "plenty strong," accepting bulk as the evidence of strength. That often meant ponderous castings, with poor distribution of weight and stresses, and in spite of the bulk, much loss on account of breakage. We are not only learning how to distribute loads to better advantage with less weight of material, but we are taking another lesson from aircraft designers and adopting more and more generally the joint that is at once lighter and stronger, the welded joint. The result is many savings other than in material which are not apparent at first, but which some manufacturers are finding a considerable factor, such as the reduction of transportation and handling charges, and of power required for operating machines, and less danger of overloading shop structures, with more latitude in arrangement of production units. The "weight mindedness" fostered by aviation is properly influencing machine design in general, and welding has proved one of the greatest factors in making weight reduction possible.

Another New Word for the Industry

A CONTRIBUTOR to the Lincoln Electric Company prize contest for manuscripts on the applications of electric arc welding suggests that each locality in the future will have among its industries what he terms a "weldery." These welderies would produce a great many articles which are at present produced by foundries. A weldery in this author's opinion would offer a complete welding service, supplying reliable data on the cost of welded parts and producing designs for welded articles as well as turning out such articles on a business-like basis just as a foundry turns out castings. There is certainly a demand at present for such establishments, because there are many manufacturers who have been attracted by the economy of welded articles and would like to use them for parts of their products, but who are not well enough acquainted with the welding processes to be able to take advantage of welding in their own plants. Whether there are enough such manufacturers at present to make the establishment of such welderies a profitable business venture would be a hard question to answer. There has been so much valuable information published on replacing cast parts by welded steel parts that there is no doubt about the possibility of this substitution being carried on on a large scale in the future. There is no reason why a weldery should not be a success. It has the same chance for success that a commercial job welding shop has. The latter gets a good deal of business from large manufacturing plants who have extensive welding departments of their own but who refer special jobs to these shops which are operated by experts in all around work. A great variety of possibilities for welded steel in machine construction certainly offers a great opportunity for plants which are organized to specialize on this sort of work on a contract basis.

American Buyers Want Quality

ONE of the most interesting business discussions we have seen in print is an article in a recent issue of Sales Management by our old friend W. T. Kyle of the Page Steel and Wire Company, who talks about what the company tells a salesman who wants the price cut. He points out that if the value of some product is noticeably less than that of a competitive product in the same price range the public quickly decides which product shall be consumed and which manufacturer shall increase or lower the price. This condition, however, does not indicate that the public demands a low price on all articles. On the contrary, the manufacturer who can keep ahead of his competitors by a particularly high standard of quality is in a position to maintain prices at a point which will yield respectable profit. If he can improve his manufacturing methods so as to decrease the production cost without the sacrifice of quality, he is likewise in a position to pass on some of the savings to the market in the form of a more favorable price without cutting himself out of his legitimate profit. And it is Mr. Kyle's opinion that the salesman who gives unduly large discounts or shaves his price under the mistaken belief that the price is the whole thing is merely cutting his own profits and contributing to the demoralization of industry. This is all very sound merchandising philosophy; it is the manner of thinking which many industries need to adopt in the current year if they are to realize their anticipation of a successful showing twelve months from now. It is easier, of course, to lower prices than to raise them. That is why price-cutting appears as a short cut in selling. But when price-cutting also involves profit-cutting then the principal reason for getting the order is removed.

Roebling

Welding Wire

In the large important steel works, shipyards, industrial plants, automobile shops, railroad shops and repair shops, Roebling Welding Wire is giving satisfactory service and demonstrating its efficiency and reliability. Roebling Electrodes are positively uniform in quality throughout the same shipment and throughout all shipments. They make the strongest and toughest welds with the least amount of trouble in welding. Roebling Welding Wire conforms to specifications of the American Welding Society.

John A. Roebling's Sons Company, Trenton, New Jersey

Better Gas Welds in Light Tanks*

Faithful Attention to Mechanical Details of Procedure Will Remove Many of the Causes of Defective Seams in Thin Sheet Steel

By H. J. Grow†

THE simple butt weld in the cylindrical shell can be made in numerous ways, with varying degrees of appropriateness depending on manufacturing conditions and arrangements. For example—the open seam can be aligned correctly for welding by the use of no other special jigging equipment than a simple claw made up of say ½ in. diameter round iron which is used to spring the edges so they are parallel and in line. They are then held in this position by tacking them with a small weld every few inches as required by the nature of the work in hand. Or again, a small bolt of suitable size for the work, say ½ in. to ¾ in. diameter with two washers and a nut and lock nut can be made up with sufficient space between the washers so that the edges of the sheet to be welded can be inserted. This bolt spaces the sheets so they are open in the direction in which the weld is being made and holds the edges in approximate parallelism and in alignment. The bolt can be mechanically driven along the sheet as the weld progresses thus keeping an open, well-aligned seam on which the welding operation must progress uniformly with the mechanical movement of the spacer, or the bolt may be driven along by the welder with a hammer. A third method, and the one most commonly used in the larger shops where the production is sufficient to warrant its manufacture, is a special jig in the form of a solid base bar of suitable shape around which the shell is positioned. On the outside there are arranged two clamping bars that hold the two abutting edges of the sheets in position on the bottom bar. The clamps and bar are preferably made of cast iron so as to lessen the tendency to warp out of shape. A jig of this type serves several purposes and assists materially in the production of straight, uniform and generally high quality welds; more will be said about this later when consideration is given to what constitutes a good weld and the precautions that are to be observed in order that good welds will always be obtained.

There are one or two things to be clearly understood, as they have a very pronounced influence on the success or failure of any welding operation. Most important among these is the preparation by correct sizing and shaping of the sheet. For example, if the edges are not sheared straight and true, there will be excess metal at certain places and at other places metal will be lacking, which deficiency will have to be made up at the discretion of the welder, by the addition of more filler material. This irregularity is reflected in the appearance, cost, and frequently in the quality of the finished weld. The quality is particularly affected adversely when there is so much excess material that the weld fails to penetrate through to the bottom of the joint. An item of even greater importance, is the proper and accurate forming of the sheets, so that no flat spot is formed adjacent to the edges. In other words, the curvature of the sheet due to its forming, either on bending rolls or in a press, must be such, that when the sheets are positioned for welding they form a true cylinder without any flat section at or near the joint. If flats are formed the edges draw up, as the weld contracts while being made. The resulting distortion of the shell not only makes it difficult to make a weld that will extend deep enough to reach all the way through the sheet, but produces a shell so distorted that a severe strain is placed on the welded joint when the shell is rounded up to permit proper insertion of the heads, or when it is rounded up by the application of the test pressure. It is also worthy of note, that the distortion due to the flat area is an accumulative distortion increasing as the weld progresses. Due to the eccentricity of the contracting weld, the deformation increases so rapidly that the weld can only be finished with great difficulty and will probably be of somewhat inferior quality.

There is also another factor to be considered when welds are made on shells having flats at the edges of the seams. It can generally be said that the poorest part of a weld is the part at the bottom of the "V" for if any lack of fusion or presence of oxide is found in the weld, it is found in the bottom of the weld metal of the original "V." Hence, with this understood, the absolute necessity of so arranging the joint that no excess strain is placed on this part of the joint is readily understood. Improper joint preparation that allows the edges to draw, aggravates this unsatisfactory condition, not only because of the poor weld metal produced and possible lack of fusion of the sheets, but when the straightening occurs, it frequently happens that the inside or bottom of the weld (as this part of the weld is distorted more than any other part of the joint) may actually crack when straightened, thus weakening the joint before it is actually put in service.

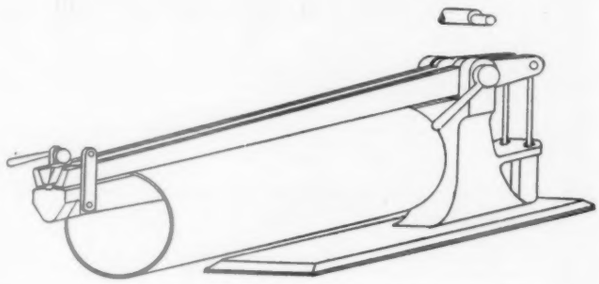


Fig. 1—Conventional Form of Jig for Welding Sheet Metal Products.

To insure the full penetration of the weld, the puddle of molten metal must extend all the way to the bottom of the original "V," or to the inside corner of the edge of the thinner sheets which do not require beveling. To do this at a fair rate of speed, a tip of adequate size must be employed. Tips capable of welding at greater speed because of the capacity to burn gases in adequate quantities permit increased heat absorption, hence, the heat will travel back into the sheet away from each side of the weld a considerable distance. If a weld of this kind is attempted without special precautions, the heat line backs into the sheet as shown by the temper colors or other discoloration of the surface. It starts as a narrow line at the end of the joint where the weld begins and widens out into more or less of a rectangular figure when equilibrium conditions of heating and cooling are reached. The boundries of this heat zone, however, may be far from straight, and may show by their irregularity the unevenness of the heating. Uneven heating causes uneven expansion and contraction, resulting in buckles and distortion but, with proper precautions and equipment, all excess heat can be absorbed and dissipated with the result that the heat line will stop rather abruptly and show as a straight line, thus reducing distortion to a minimum (see Fig. 2).

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Another of the common faults resulting from the attempt to secure high speed welding with large tips, using a considerable amount of filler material on thin gauge plates, is undercutting and consequent thinning of the sheet at the edge of the weld. This undercutting sometimes occurs on one side of the weld only, and sometimes it is found on both sides; it causes a serious weakness, as well as decidedly marring the appearance of the finished weld. Results of this kind indicate either a decided lack of skill on the part of the welder, or gross carelessness (Fig. 3, D & F). Undercutting can always be prevented by an even heating of the edges of the sheets with the even addition of the welding rod. Undercutting is particularly prevalent on the

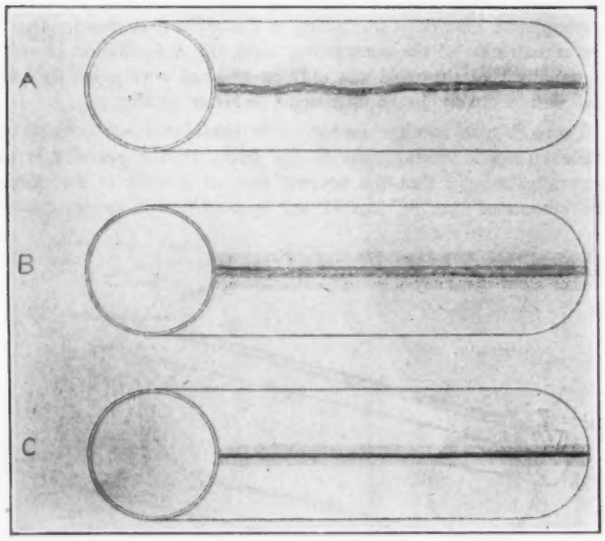


Fig. 2—A—Heat Zones, Irregular Welding; B—Heat Zones, Uniform Welding; C—Heat Zones, Uniform Welding with Chills.

type of weld used to join the head to the shell, in which case it is generally due to the angle at which the torch and tip is held. Under certain conditions, the molten metal is actually moved by the application of the flame from the head at the edge of the weld to the thicker portion of the weld, thus removing it from the point where it is really needed to a point where it serves no useful purpose (Fig. 3, A).

The first suggested method of simple tacking after the sheets are sprung into a position of suitable alignment, with subsequent welding from one end to the other of the joint, produces a good weld if proper welding procedure is employed. However, if heating distortion as described above is to be controlled and prevented to the extent that the joint will have the proper appearance, a small tip must be used and the operator must give strict attention to the work. Most welders of today, on account of the conditions usually found in shops, will not give the attention and concentration to this sort of work that is necessary if high quality is to be attained. Also, in this sort of joint, where there is no chance for a general movement of the sheets to relieve the strains of welding, more strain is set up in the joint and adjacent to it, than in joints where the sheet can move readily. (From the shop's standpoint, however, there is a very real advantage offsetting these criticisms, for with this type of procedure the steady progress of the actual making of the weld, which must be observed in other methods, can be ignored.) No relative movement of the sheets will occur during the interruption, which would interfere with the continuation of the weld afterwards, if the joint is properly tacked. The strains set up is a matter not readily determined, although it can be easily shown that they sometimes reach a fairly high percentage. Regardless, however, of these strains, a good gas weld will not fail to stand up and perform its full function under these conditions. To sum up with this type of procedure, no special equipment is required, small tips are used, and the welding technique is easily learned, for the operations are not speeded up and the welds are usually of good appearance and quality. Offsetting these good points, are the facts, that the welding rate is low, the welder's concentrated attention is required, and the finished weld may be under more strain than is the case under other welding conditions.

The second method described is also simple, insofar as the equipment required is only a bolt of suitable size with washers and nuts or other simple spacing devices. The actual operation, however, is not quite as simple as it appears, for the quality of work and its expeditious completion is generally left entirely to the welder, who welds at any rate he chooses and otherwise controls the results. In this method of procedure, the sheets are always set with the conventional wedge shaped opening, the angle of which is made to suit the rate of welding, amount of heat used, and the characteristics of the sheet being worked on. If the welder operates at a uniform rate and does not stop welding until the weld is entirely completed, very satisfactory work is invariably produced. This method, however, depends entirely on the correct forming of the sheet as previously explained and the thorough training and skill of the welder, for the welder cannot interrupt the even continuous advancement of the weld to correct badly formed joints, or the crawling of the sheets should they not lie quietly as the weld progresses, because when he pauses the heat zones do not remain stationary. The zone of increased heat moves outward and finally the rate of heating is equalized by the rate of cooling and the job cools off. While this is going on there is a constant movement of the edges of the sheet yet to be welded, with the probable result that when the welder resumes activity the sheets are so badly out of line as to interfere with the welding. If the interruption is prolonged, the edges at the extreme end of the seam may even overlap. A study of the contraction forces which caused the misalignment or overlapping due to cooling, indicates that reversal of these forces by expansion through intelligent reheating, will restore the edges to approximately the original position when welding ceased and welding can then be resumed. Various modifications of the method of welding just described are used in some instances to the extent of moving the wedge or clamp mechanism uniformly along the joint ahead of the weld, by power, and thus try to establish the rate of welding and cause the entire seam to be completed without interruption. These devices, however, good as they may be for the purpose of securing certain features, introduce more complications than need be, as will be seen when the next method is described.

The third method mentioned, the use of a specially designed clamp, is perhaps the best of the three and more generally used. We will try to describe herewith the fundamental reasons why these clamps assist, as we believe shops frequently use this method because it is the generally accepted one. If the functions and their influences were better understood minor difficulties in the use of these clamps would be more readily corrected and their full value obtained.

Realizing the fundamental nature of these factors of good welding, let us repeat the very important reactions to be considered and to which proper attention should be given if a good appearance and strong longitudinal butt welds are to be produced. It is of the greatest importance that the weld is carried entirely through the full thickness of the sheet. The welded portion must be practically symmetrical with respect to the center line of the shell, and it must be steadily and uniformly made from one end to the other. One need hardly mention that the metal of the weld must be of high quality and free from porosity or laminations; this desirable condition is bound to follow the use of suitable material and apparatus when the welding technique follows generally recognized and approved procedure.

Let us see how these factors are affected by the use of suitably designed clamps as mentioned in the third method.

One of the important advantages of the clamps providing they are of sufficiently heavy construction, is that the sheets are shaped and brought into absolute alignment. The clamps also restrain the sheets so that the sheets creep in at a uniform rate through the clamps to close the wedge shaped opening always left between the edges of the sheet when the weld is started. This movement allows the normal motion of the edges and greatly helps to keep

the shell properly and correctly positioned and satisfactorily shaped when the weld is finished. The clamps also act as chills carrying off excess heat and allowing the use of more heat through the use of a larger tip and flame than would be possible without the use of clamps; this in turn means a greater footage of welding per day. With the uniform cooling the welder will find it less difficult to carry a full sized puddle, heating and cooling rates will be more uniform and therefore, more simple to control. As previously referred to, the clamps allow the sheets to move in their normal manner when subjected to the heating and cooling cycles of the progressive welding operation, but at the same time, the edges are positively restrained from moving out of line and setting up the condition of eccentric welding explained in connection with the use of the second method.

Minor advantages of the clamps are, the simple set up afforded, and guide furnished the torch in some classes of work.

In designing welding fixtures of the clamp type, allowance must be made for the following general provisions. Cast iron should be used throughout for those members that must hold the sheets in line while being subjected to heat from the welding flame. Rolled steel members generally are not satisfactory for this service as they change shape more rapidly under repeated heating and cooling. Sufficient backbone must be built into the horn and clamping members so that when the desired pressure is exerted there will be uniform contact along the entire length of the seam. The distance between the top clamps and the top of the horn immediately under the weld must be altered to suit the various thickness of material. Provision should also be made to vary the space between the clamping members so as to present an adequate area of steel on either side of the seam so that a sufficiently rapid absorption of heat may occur and welding accomplished with speed and thoroughness. If maximum benefit is to be secured, it should be noted that with a wider space less heat will be lost into the clamps but the operation requires more care on account of less rigidity of the unsupported edges, less accurate positioning and less rapid chilling; a space that is too narrow increases the difficulty of making a weld completely through the sheet to such a point that it may be impossible to secure complete penetration without using a tip so large that the weld is apt to be overheated. When only a little space is provided, in a jig of this kind, the welding apparatus is apt to suffer severe abuse due to the confined heat from the secondary flame.

To sum up for this method, a properly designed clamping device simplifies the welding of the most important joint by correcting slight irregularities in the forming; by providing a guiding action assisting in the seam alignment and by restraining or controlling the draw of the sheet as the weld is being made. Welders are easily taught when seams are accurately positioned and uniformly good welds can be made, higher welding speed can be secured through the simplified heat control and ease of carrying a full-sized puddle and straight seams of good appearance can easily be obtained.

Various problems are presented with the different designs of head seams. In the case of the butt joint the shell and head flange must first of all be exactly of the same size and contour or they cannot be properly fitted up. Next, the edge of the shell acts as a rigid member when the weld is being made, and starting at one point and welding continuously around the shell until the starting point is reached, some expansion difficulty will be experienced. There is a simple remedy for this trouble, through the accurate positioning of the head in respect to the shell and tacking the head securely in position on the quarters or in smaller subdivisions. Each subdivision can be welded without undue distortion or straining of the weld as the flexibility of the head will relieve the principal stress set up by the contraction of the weld.

The lapped type of joint is the most common for it permits a very satisfactory and simple type of set up, and gives satisfactory service. Sometimes in joints of this type the head is inserted only far enough into the shell so that the weld is a simple lap weld on the straight portion of the flange of the head. While this gives certain advantages, through saving weight and making a simple set up operation, a very much stronger type of joint can be secured if the head is inserted further into the shell and the end of the shell crimped down over the knuckle of the head so that part of the load on the head, when the tank is under pressure, will be carried by the shell irrespective of the amount transferred through the weld. The principal difficulty experienced in making either of these types of welds is that of securing close contact between head and shell before the weld is made and during its actual progress.

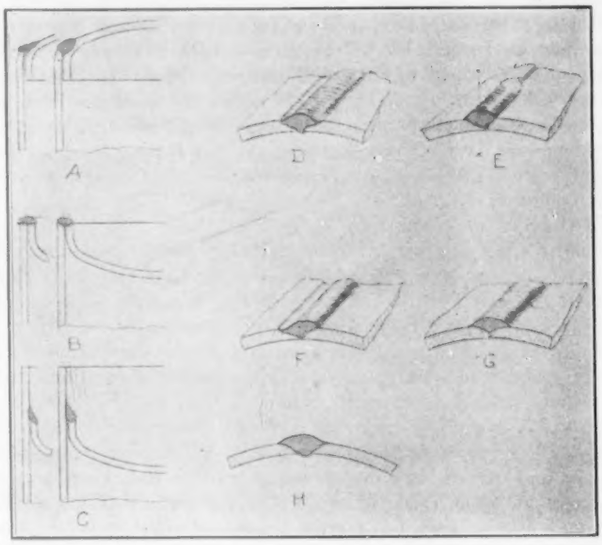


Fig. 3. A—Correct (right) and incorrect (left) weld joining top and shell; B—Correct (right) and incorrect (left) edge weld joining bottom and shell; C—Correct (right) and incorrect (left) fillet weld joining bottom and shell; D—Incorrect butt weld, thin at edges through overheating; E—Incorrect butt wed with insufficient penetration due largely to eccentricity of weld; F—Incorrect butt weld, thrown on one side through uneven application of heat; G—Incorrect butt weld through lack of penetration; H—Correct appearance of butt weld.

It a space is left, good welding is made more difficult. As the weld progresses the outside sheet expands so that it becomes increasingly larger than the inside member thus aggravating the condition. The heads are usually welded with the shells in a vertical position and the weld is therefore horizontal and easily made. Much of the quality of this weld depends on the provision made for the comfort of the welder and the facilities offered in the way of turning the tanks, keeping the various lengths and therefore, heights of the tanks at suitable and convenient welding positions.

In the welding of the conventional bottom which is inserted so that it is concave on the outside, it is possible to so arrange the weld that an edge weld can be made. On the other hand, the bottom may be inserted further into the cylindrical shell with the result that a lap weld must be made in a confined space frequently some distance from the outside edge of the shell. When attempting to make the latter type of weld the position of the tank with respect to the welder is important. To explain this let us point out that the tank must in the first place be in a position (if the weld is made some distance from the outside edge) so that the reflected heat can be directed away from the welder in such a manner as not to interfere with his comfort or his ability to see the weld he is making. Consideration of this feature will also lead to less abuse of the apparatus than if the full reflected heat is allowed to go back around the torch.

It will be found preferable from quality and cost considerations, to make the weld a short distance from the bottom center of the circle rotating the tank periodically and frequently as the weld progresses. Where the welder is working on a piecework rate, in which time is the only factor considered, he will soon find out that a faster weld can be made if he carries his weld so that it advances in a downward direction. The reason for this increased speed is because in this position the hot metal in the puddle because of its fluid condition tends to drop downward over the

parent metal very readily and because of this tendency, the welding rod is usually fed into the weld faster than the surface of the parent material is heated to fusion.

When the welder carries his weld downward in this manner, it will generally be observed that the weld is thin and sometimes hollow, also it is more prone to leak because of cold shuts due to improper fusion with the parent metal. It is generally conceded that welds made in this direction, unless the welder is particularly competent, are inadvisable. On the other hand, welds made upward in a vertical direction on account of the natural repose of the fluid weld metal, will fill out to reasonable thickness and will be found well fused to the parent material. While it is true that many welders can only make a weld where the welding is done in a flat or horizontal position, it is not difficult to teach them to weld upward in a vertical direction. If this is done on this type of work, good welds will be made and less rigid inspection will be found necessary.

An edge weld joining the bottom to the shell is not satisfactory when high test pressures must be carried, for in this type of weld the weakest point of the weld is found at the point of greatest stress. Also, it is obvious that reinforcing on a weld of this kind cannot increase its strength beyond a certain value for the strength of the joint is determined at a point through the sheet at the bottom of the weld. There is also to be considered in connection with the statement concerning the strength of an edge weld, the fact that a poor weld may readily result through carelessness in work of this type, because practically all of the heat that is absorbed and carried back into the sheet must be picked up largely through the edge, rather than through the surface of the sheet, where a greater area for a given volume of metal would be exposed to the heating action of the flame.

In the general classification of welds on light gauge tanks there is one that offers an interesting problem, namely, the joining of the heavier sections to the lighter sections made necessary because of the common method employed for making connections to the tanks. Pipe connections are generally made by means of drop forged spuds of particular design which are welded by means of a fillet weld to the heads, bottoms or shells, as required for the particular use and design of the tank. It is common practice in most shops to have the beginners and less-experienced welders weld the spuds into the heads before the heads are welded to the shell and to weld the spuds to the shell after the tank is practically completed in other respects. It is very common practice, because of the likelihood of overheating the thin section or underheating the heavy section, to preheat the spuds which are of the heavier section, in a small oil-fired muffle furnace and apply the spuds which are red hot, to the shell and immediately weld them. When doing the welding this way it becomes a very simple operation, as the rate of heating of the two different sections is equalized. Good penetration is easily secured together with a very nicely finished appearance of the weld. Considerable time and gases are saved, all of which in the long run, more than pays for the additional effort and cost of the preheating.

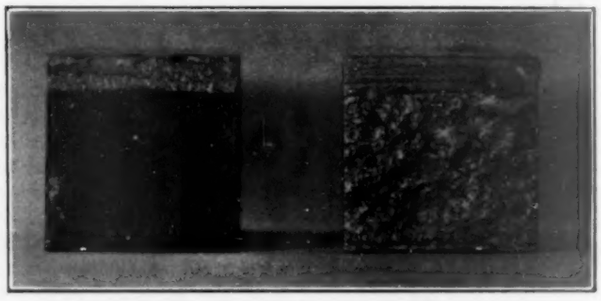
In the case of the conventional short spud little or no trouble is experienced in making the weld so that the threads will properly line up at right angles or any other predetermined angle to the surface to which they are attached. However, when the longer fittings are used particularly in the case of larger diameters and heavier material, care must be exercised when setting the job up for welding so that when the final contraction of the weld has taken place, the spud will be in correct alignment. The common method of accomplishing this is to purposely set the spud up out of the line it must occupy when finished, in such a manner that the contraction of the weld will draw the spud so that it will be in correct alignment when cold.

This may sound like a complicated procedure, but it really is not, for with a very small amount of experimenting concerning the correct place to start and stop the weld and the amount of misalignment to allow in the original set up, will permit the establishment of a procedure which, if followed, will insure all the spuds being in approximately correct alignment when the job is completed.

SAND BLASTING AS AN AID TO THE TINNING AND BRAZING OF CAST IRON

By C. H. Hollup, Vice President, C. H. Hollup Corporation, Chicago, Ill.

The tinning or brazing of cast iron is not always as successful as one would like to see it. In the soldering or brazing of castings it is often noticeable that the tinning coat runs off—as water would run off an oily surface. Apparently it does not adhere to the cast iron. It is my contention that this is due to the amount of free graphite carbon existing in grey iron, of which in some cases, there is so much present that one is able to write on paper with such a piece of cast iron. It is this carbon, which is non-metallic and will not tin, that prevents the particles of exposed iron from taking on an uninterrupted coat of tin or bronze. Some people use Blue Vitriol for copperizing the surface of the iron in the belief that this will help the tinning. However, in this case also, it is only the iron net work that takes on copper and therefore is of no benefit. The machining of the surface, such as filing, turning or planing, does not alter the aforesaid condition whatever, as the carbon is present throughout the casting and will always be present on any newly created surface. Pickling has the same effect as machining and will produce a clean metallic surface to the extent that the carbon present will allow.



**Left—Broken Casting Refuses to Take Tinning Coat.
Right—Opposite Side of Break, Sandblasted and Tinned.**

Some time ago, my attention was called to the Babbitting of large cast iron bearing shells. It had been difficult to make the Babbitt adhere tightly to the cast iron wall, although tinning of the casting had been resorted to. When the Babbitt in the shell was struck with a hammer it did not give a clear metallic ring—but a leadlike, hollow sound; indicating that the Babbitt had shrunk away from the casting although considerable anchorage and machined surfaces were provided. Being extremely careful to have clean surfaces on the casting before tinning, I resorted to sandblasting with surprising results. Wherever the sandblasting took effect, the tinning at once showed remarkable improvements.

Carrying on experiments, I found that the unmachined surfaces tinned fully as good as those that were machined. This also holds good on Steel Castings. In fact, it appears that the tinning is even better on rough surfaces such as broken pieces of casting; or the scaly looking surface of any casting, after it had been sandblasted. This may be due to the minute crevices in which the tin finds ample anchorage. My theory on the foregoing is that the fine particles of sand in sand blasting, thrown against the surface, will attack the graphite more than the iron and pit it out, leaving an entire metallic iron surface, which is most suitable for tinning.

Pipe work in refrigerating plants is very often soldered into Semi-Steel Fittings to make them ammonia tight. This solder acts just about as so much putty, as it does not bind to the fitting, and in unscrewing the pipe from the fitting it will take the entire solder ring with it. Sand Blasting of the fitting will prevent this.

Spot Welding Solves Factory Problems

Perfected Methods of Application Make Possible Fabrication of Many Pieces Into Unit Which Shows No Sign of Joint

ON close inspection of either the electric refrigerators or electric ranges made by the Edison Electric Appliance Company, of Chicago, one who had not seen them in production might be mystified as to how the various parts were joined together, for there is very little evidence of a joint or seam of any kind. This is particularly true of the box of the refrigerator, which has every appearance of having been formed from one piece of metal.

The fact is that there are over forty pieces included in the box and door assembly, all joined without a rivet and with no screws or bolts except on the hinges and some ornamental finish metal at the corners. There are two reasons for this pleasing and practical continuous surface, inside and out. One is the fact that all of the oxy-acetylene welds joining the principal members are

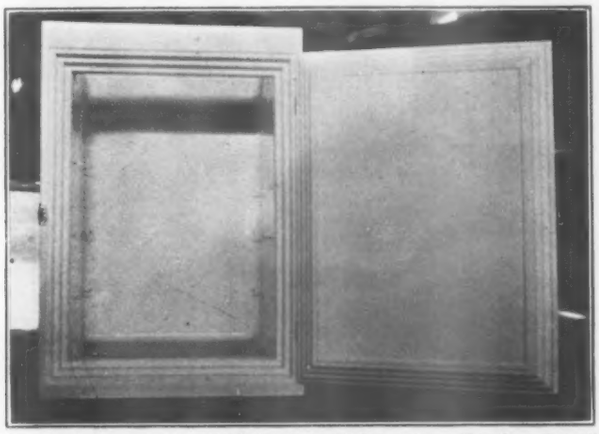


Fig. 1—Storage Unit of Mechanical Refrigerator, Showing Rounded Corners and Absence of Visible Seams.

finished down flush with the surface of the sheet by means of filing and grinding. The other reason is the method of making the scores of spot welds, which cannot be detected even on the large enameled surface on the exterior of the box. These sheets are of thin Armco iron, 0.025 to 0.028 in. in thickness, to which several cleats and reinforcing strips of different thicknesses have been spot welded on the inside. Yet these welds require no grinding or finishing down whatever to prepare a smooth surface for the enamelling or painting.

Although a considerable amount of interesting gas welding is done on these boxes, this article concerns chiefly the ingenious devices which have made possible the use of spot welding to obtain economical production and at the same time retain certain very essential qualities in the finished product.

The procedure which makes such smooth spot welds possible is the result of much experimenting at the plant of the Edison Electric Appliance Company. It is, however, quite simple. The upper electrode of the spot welder is shaped to the customary blunt point. The secret lies in the lower electrode, the contact surface of which is a flat piece of copper about ¾ in. square. A very slight indentation, not more than 0.005 in., is hollowed out of the surface of this electrode, thus providing a bulge to the same amount on the plate when the weld is made. On cooling, the contraction of the metal draws this bulge down flush with the surrounding surface, with the result that even before the application of the paint or enamel finish, the welds are hardly noticeable on this side of the sheet.

The greater part of the spot welding is used in attaching the reinforcing strips to the inside of the box and to the lining and the door front, but is also used in tacking together some of the assemblies in preparation for the oxy-acetylene welding, and in attaching small cleats of ⅛ in. material to provide the necessary thickness of metal for handle and hinge screws.

A particularly interesting application of spot welding is found in the joining of the door plate, which is of Armco iron, to the door throat, which is of Ascoloy steel. This heat resisting

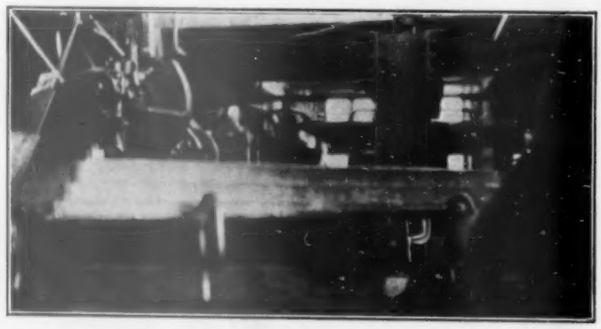


Fig. 2—Spot Welding of Armco Iron Door Front to Throat of Heat Resisting Alloy Steel.

metal is used wherever there is a possibility of escape of cold through conduction, such as at the contact between the door throat and the box throat, and at the opening at the top where the refrigerating unit fits into the storage unit. In spite of the thinness of the Ascoloy, 0.018 in., 50 per cent more current is required in making these welds than in joining the ⅛ in. cleats to

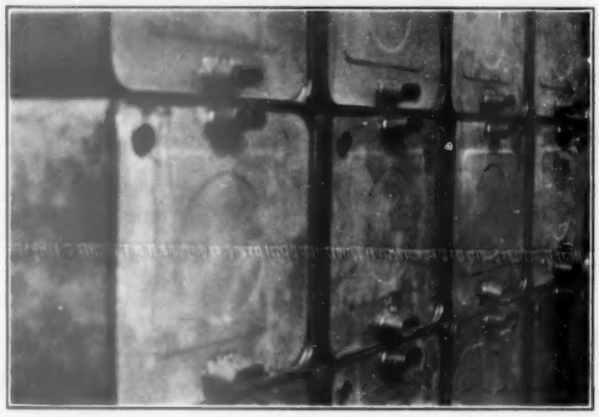


Fig. 3—Rear View of Seam Welded Inner Lining of Electric Ovens, With Terminal Tubes Attached by Spot Welding.

the Armco sheet. The entire assembly of 30 welds, around the four sides of a rectangle about 30x36 in., is completed in 30 seconds.

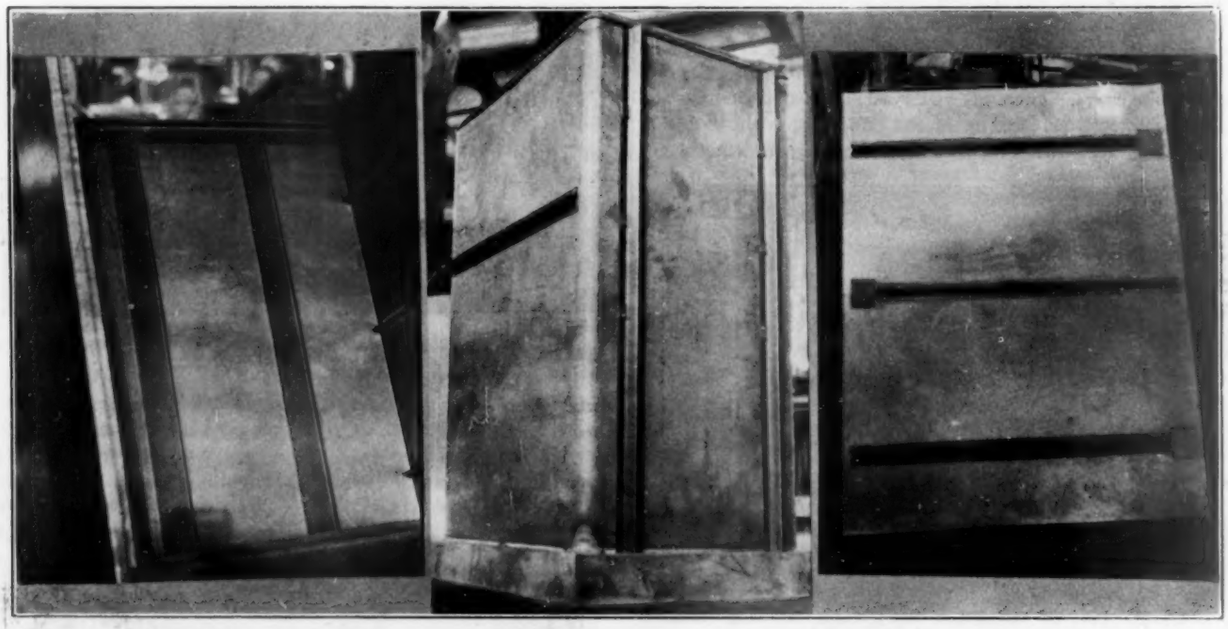
The writer had an opportunity to observe the tearing apart of one of these doors, and each weld yielded only after considerable prying, leaving in most cases a hole in the iron sheet. The welds on every unit are, in fact, put to a test in the process of packing the boxes and doors with balsam wool insulation, which is forced in with a hydraulic press.

It has not been found necessary to prepare the metal in any way, by cleaning or grinding, in order to secure sound welds. A specially processed 22 and 24-gauge rustproof sheet is used in the range ovens, but this surface treatment does not interfere with the resistance welding. Tests of spot welds on this material showed the same results as those on the refrigerator door.

Three Federal Junior Type 124 spot welders take care of all of the resistance welding on the refrigerators. In the electric range department at this plant are a Gibb Junior seam welder, two Federal spot welders, in addition to Thompson, Toledo, and Winfield welders. The Winfield machine is provided with a horn electrode for welding the terminal tubes to the oven.

The outer oven assembly of the electric range consists of twelve principal parts, all spot welded together. The inner lining of the oven is seam welded because of the necessity for an absolutely airtight joint. The Gibb welder, rated at 20 KVA, operates on this job at 12 KVA, producing 12 feet of weld per minute. This is about ten times as fast as any previous method of making this joint.

The same method is used in spot welding the ranges as on the refrigerator boxes to prevent the marring of the surface by the welding operation. From the standpoint not only of appearance, but also of strength and efficiency of these products, as well as economy of the production welding procedure, resistance welding has filled every requirement in the rapid, positive joining of the metal parts.



Left—Inside of Outer Shell with Channel Reinforcing; Center—Inner Lining with Reinforcing Strips; Right—Door Front with Similar Strips and Cleats for Attaching Handle and Hinges. All Parts Spot Welded.

ELABORATE BOOKLET ON ORNAMENTAL IRON, BRONZE AND WIREWORK

The National Association of Ornamental Iron and Bronze Manufacturers has prepared a 68-page brochure which presents very effectively the possibility of rendering a building more artistic and beautiful through the proper use of ornamental grilles, railings, doors, windows, stairways, etc. Many of the specifications given specifically mention welding as a means of forming and assembling these intricate designs, and all of them look as though welding could be used to great advantage in their fabrication.

NORTH TEXAS AGRICULTURAL COLLEGE TO HOLD SECOND WELDING CONFERENCE

Announcements of their second annual welding conference have been issued by the North Texas Agricultural College, at Arlington, Texas. The conference will be held on February 7th and 8th. A program is promised which will be of considerable interest and value to both arc and gas welders.

RYERSON SALES CONVENTION DEVOTES SESSION TO WELDING

During the week of December 27th to 31st Joseph T. Ryerson & Son, Inc., held a sales convention of their national organization at the main office of the company at Chicago. Besides the Chicago office, representatives came in from the branches at Jersey City, Boston, Buffalo, Pittsburgh, Cleveland, Cincinnati, Detroit, St. Louis and Houston.

This company considered welding of sufficient importance to devote an entire session of the convention to the subject. Sales representatives were instructed in the latest developments in the uses of welding and were shown the influence the properties and characteristics of various grades of welding wire have on the results obtained. Stereopticon slides and motion pictures were used to illustrate the effect of certain additions to the wire and to its coating under actual operating conditions.

Joseph T. Ryerson & Son, Inc., established for many years in the iron and steel trade, are now also distributors for the Weldite welding rods and electrodes and for the Wilson arc welding machines. Ryerson thus stands in the unique position of being not only distributors of nationally known welding equipment and supplies, but also the materials to be welded, such as plates, rods, bars, and all structural shapes. With their sales organization of about 125 men, eight plants and offices in ten cities, they are in a good position to render efficient service to users of their steel products by assisting them in solving any problems involved in fabricating by welding of these standard steel shapes. With the present growing trend toward substitution of welded steel for castings, and of welding for riveting in much building construction, this combination of the raw materials and the fabricating equipment from the same source of supply provides reason enough for giving such attention and study to welding in general as the Ryerson organization are now devoting to the subject.

VENEZUELA PLANT NEEDS OPERATORS

The Commercial Gas Company at Minneapolis, Minnesota, is endeavoring to obtain for a client in Venezuela a good oxygen plant operator who thoroughly understands the operation of the Messer air liquefaction oxygen plant and who can make repairs on a column when necessary. Mr. Caluwaert, of the above Company, has complete information available regarding salary and terms.

Studies of City Gas Cutting

Investigators in Shop and Laboratory Point to Importance of Preheating Flame and Surface Condition of Metals to Be Cut

MUCH interest has been shown in two studies of the merits of city gas in cutting operations, as compared with acetylene, which were presented before the recent meeting of the International Acetylene Association at Chicago. The comparison as made from the laboratory viewpoint was presented by J. K. Mabbs, of the Union Carbide Sales Company. An abstract of his paper follows:

Fundamentally, metal cutting is a two-part process. The first step—preheating—consists in heating a small portion of the material to the "kindling" or ignition temperature. The second step—cutting—is the "burning out" or oxidizing of a narrow width of the preheated metal along some designated path by means of a jet of oxygen under suitable pressure. If the temperature of the metal could be raised to the proper point as rapidly with one fuel gas as with another, there should be practically no difference in the rate of cutting. In making this comparison of the relative merits of acetylene and city gas as fuel gases from a laboratory standpoint, therefore, consideration has been given mainly to factors pertaining to preheating.

There are some technical points in connection with preheating conditions which should be studied before presenting experimental data. The first of these is flame temperature. No apparatus has yet been developed which will accurately measure these temperatures and it is necessary to calculate them by a very involved mathematical process. Earlier determinations naturally do not consider a number of conditions now known to occur in the reaction, such as the increase in specific heats of gases with temperature and the dissociation of carbon dioxide, water vapor, or molecular hydrogen. The inclusion of these factors gives results which more closely approach actual maximum temperatures. However, they are considerably lower than the older values and a correct comparison cannot be made unless it is known that the same procedure has been followed in making the calculations.

Another point which is often neglected in comparing flame temperatures is the quantity of oxygen used to effect combustion. A deficiency or an excess of oxygen causes an appreciable variation in these values for any one gas. For example, there are three equations expressing the reactions of acetylene and oxygen, dependent upon the oxygen concentration:

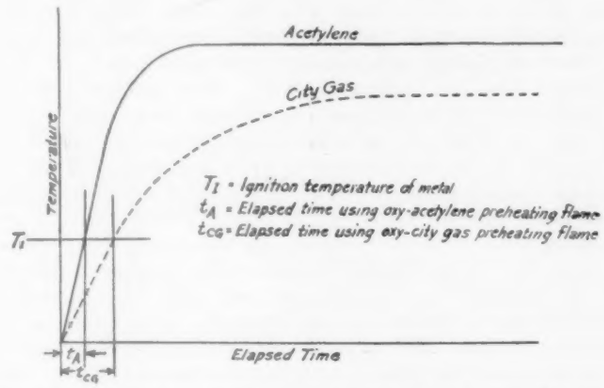
$$C_2H_2 + 5/2\ O_2 = 2\ CO_2 + H_2O + 302{,}000 \text{ calories} \quad (I)$$

$$C_2H_2 + 3/2\ O_2 = 2\ CO + H_2O + 166{,}000 \text{ calories} \quad (II)$$

$$C_2H_2 + O_2 = 2\ CO + H_2 + 102{,}600 \text{ calories} \quad (III)$$

The theoretical flame temperatures corresponding to the three reactions corrected for dissociation of carbon dioxide, water vapor, and molecular hydrogen, are 5935°, 6017°, and 5500° F., respectively.[1] In addition to this, the proportion of oxygen required for the most effective preheating flame varies for different fuel gases. Unless the gas ratio (volumes of oxygen per volume of fuel gas) is specified, so as to indicate that the oxygen consumption is for theoretically complete combustion, or for best operating or other similar conditions, a comparison of flame temperature data is meaningless.

There is also a tendency to rate fuel gases on the basis of the total heat evolved during combustion. If this were true, butane with 3107 B.t.u. per cubic foot would be immeasurably better than acetylene or hydrogen, which develop 1434 and 273.3 B.t.u. per cubic foot respectively.[2] However, the proper classification is also dependent upon the volume of the products of combustion. With this factor included, the heat intensity rating shows acetylene first with 97.0, hydrogen next with 90.6, and butane in third position with only 84.4 B.t.u. per cubic foot of air combustion products.[3]



Relative Rate Temperature Increase of Clean Metal Surface with Oxy-acetylene and Oxy-city Gas Preheating.

A compilation of combustion and flame temperature data, taken from recent and authoritative sources, shows a wide divergence between flame temperatures where dissociation effects have been considered and those where no correction has been made. It is recognized, of course, that oxy-acetylene combustion produces the highest known gas flame temperature, and one exceeded only by the electric arc-induced atomic hydrogen flame.

Observation of the values mentioned shows that for combustion in air the flame temperatures of various compositions of city fuel gas are in general of about equal magnitude and that the acetylene figure is approximately 500° F. (13%) higher. In the one case where a comparison can be made between flame temperatures for theoretically complete combustion in air and in oxygen, the acetylene-air figure is 490° F. (13.4%) higher than that for city gas-air; whereas when burned in oxygen, the advantage is 835° F. (16.4%). The relations between acetylene and other fuel gas flame temperatures in air remain practically unchanged, therefore, when the higher values resulting from combustion in oxygen are compared.

This excess temperature is the margin which enables the cutting torch using an oxy-acetylene preheating flame to make a quicker start, even on perfectly clean metal. A

[1] *Goodenough & Felbeck, U. of Ill. Bull.* 139 (1924), *pp.* 85-92.

[2] *"Combustion," American Gas Association, 2nd edition* (1926), *p.* 18.

[3] *Corrected for dissociation in accordance with method outlined in "Combustion* (1926), *pp.* 52-53.

clearer conception of this advantage of acetylene over city gas can be given by considering the somewhat analogous case of plunging a metal rod heated to a certain temperature into a quantity of water, observing the time necessary to increase the water temperature 5°, and then repeating the test with the rod at a temperature 100° higher. The latter test (typifying the acetylene flame) naturally requires a shorter time. Figure No. 1 shows a graphic representation of the rate of increase in temperature of a clean metal surface under the action of acetylene and city gas preheating. The times required to reach the ignition temperature (T_1) are the distances t_A and t_{CG} respectively. Since the city gas temperature increase curve is more gradual, due to the greater proportion of heat conducted away or otherwise dissipated from the surface being heated by this lower temperature flame, the latter distance represents a longer time interval.

This advantage of acetylene is emphasized when the surface of the metal is coated with rust, scale, paint, sand or slag in the case of castings, or similar materials of low heat conductivity. Under such conditions, the metal is in a measure insulated from the preheating flame. With the lower flame temperature and hence lesser heat input into a substance through which heat is transmitted with difficulty, it is evident that more of the available heat of a city gas preheating flame will be dissipated before the metal reaches the ignition point than is the case for acetylene. It is this lack of reserve temperature which necessitates decreasing the cutting speed when a dirty spot on the metal is encountered, in order to allow the less intense heat of the city gas preheating flame sufficient time to remove the coating and bring the metal to the ignition temperature. Figure No. 2 depicts the rate of temperature increase of a scale-covered metal surface with the two methods of pre-heating. The very slow transmission of heat from scale to metal at the lower temperature results in an abnormally long preheating period (t_{CG}).

Attention has already been directed to the oxygen requirements of a preheating flame and it has been shown that for theoretically complete combustion acetylene requires 2.5 volumes of oxygen (reaction I). However, the primary phase of the flame (reaction III) indicates that only one volume of oxygen is necessary, oxygen for the secondary phase being drawn mainly from the surrounding air. This is substantiated in practice, best operating conditions being obtained with a "neutral" flame where the gas ratio is only slightly greater than 1.

With city gas a reverse condition holds true. The theoretical gas ratio for complete combustion of a city gas is frequently less than 1, dependent upon the composition of the gas mixture. But to secure the greatest efficiency with this fuel, it has been found necessary to increase the supply of oxygen well above the theoretical proportion and operate with a strongly oxidizing flame.

Tests to investigate the correctness of these various deductions have been made under laboratory conditions where all experimental factors could be carefully controlled and observed.

The first series of tests afforded a comparison of the preheating periods for acetylene and city gas. Before conducting the final tests, many preliminary trials were made to insure the most effective oxygen concentration, style of tip, proper distance between torch tip and plat surface, etc. On clean, sharp-edged steel, the preheating periods averaged:

Material	Acetylene	City Gas
½" plate	1 sec.	2 sec.
2" plate	2 sec.	4 sec.
6" billet	3 sec.	10 sec.

Both gases made satisfactory and comparatively rapid starts under these favorable conditions. Considerable difficulty was experienced, however, in getting a cut under way in a typical 12" steel billet with city gas preheating. At times the preheating interval was about ½ minute, but in other tests 2 minutes or more was necessary. In contrast to this, acetylene started the cut in 5 seconds without difficulty.

In another laboratory test on rusty ⅜" boiler plate, it was impossible to maintain a steady rate of cutting with city gas. Thick scale caused frequent stops, at which time it was necessary to shut off the cutting oxygen and let the preheating flame heat the metal sufficiently to start the cut again. No such action occurred during the acetylene cut. In consequence, the city gas cutting time was 4½ minutes as against only 2½ minutes for acetylene.

A test on the scrapping of lengths of lapped ship plate covered with paint showed an average of 12 seconds preheating time per cut with city gas in comparison with only 3 seconds for acetylene.

In cutting rivet heads, the preheating time averaged 6 seconds for acetylene and from 13 to 25 seconds for city gas, depending on the type of torch used.

Other tests were made to determine whether major defects in steel risers, such as blowholes and included sand, offered greater obstruction to cutting with city gas than with acetylene. Holes ½" in diameter were drilled diagonally across the end of a 6" billet. With acetylene, the cut was made in 1¼ minutes. The holes cause very little slowing up, the kerf was straight and the quality of the cut good. Using city gas, the cutting time was 2¼ minutes (80% longer) and there was an appreciable drag under each hole. Insertion of a carbon rod (to introduce a non-fusible material similar to burnt sand) did not seriously affect cutting although the retarding action was more noticeable with city gas.

A 1" hole in the center of the billet was passed with greater facility by aceteylene. The placing of a ¾" carbon rod in the above hole created a condition which was overcome successfully, although with some difficulty, by acetylene. The city gas cut was practically stopped, however, and a very large cavity was burned in the steel, after which the carbon rod fell out.

In practice, the effect of such conditions is illustrated by the case of a company using city gas for riser cutting. The cost of this operation became so excessive, because of difficulty in starting the cut, that it was found necessary to have castings made with a narrow vertical rib or fin of metal on one side of the riser. The additional molding expense failed to accomplish its purpose of reducing the cost to a figure comparable with that for acetylene.

The next investigation was on the effect of the oxidizing city gas preheating flame on gas ratio and oxygen consumption. Tests were conducted on the city gas used in some of the preceding work which, from the composition data recorded in Table No. 1, had a gas ratio of 0.9175 for theoretically complete combustion. Several styles and sizes of tips were employed, the cuts made at the maximum possible speed, and the torch pressure adjusted accordingly. Since the readily observable features of the reducing, neutral, and oxidizing actylene flames are not visible to any marked extent in the city gas flame, considerably greater skill was necessary to adjust and maintain the character of this flame correctly. The most satisfactory preheating conditions were obtained when a highly oxidizing flame was used, the gas ratio ranging from 1.24 to 2.03 and averaging 1.48. Similar tests to check the theoretical gas ratio for acetylene varied from 1.11 to 1.21 and averaged 1.15, which agrees very closely with accepted operating figure. On the basis of equal gas consumption, therefore, city gas preheating will require approximately 30% more oxygen than is necessary for acetylene. But, in addition, it was found that anywhere from 1½ to nearly 6 times as much city gas was used. Neglecting for the moment any time factor,

it is apparent that under the most favorable preheating conditions, the oxygen consumption of city gas is practically equal to the combined volumes of oxygen and acetylene required for oxy-acetylene preheating.

Thus far the factors considered have dealt with preheating. However, the experimentation disclosed another point in connection with the advantages of acetylene in severing dirty metal. This was the result of two sets of cutting tests, one on clean material and the other on billets in normal condition as to scale. In the first case, the differences in cutting oxygen consumption with acetylene and city gas were relatively insignificant. But, when the regular run of scaly material was encountered, the inadequacy of city gas preheating was clearly demonstrated, nearly 30% more cutting oxygen and 35% additional time being required for the cuts.

This difference brings up the question of cost. Economy is perhaps the most important argument advanced by the advocates of city gas and this, of course, is based on the wide difference in the price of the two fuel gases. Acetylene ranges from $.011 to $.015 per cubic foot for generated gas, while city gas (which in some cases is natural gas) can be purchased for from $.35 to $1.15 per thousand cubic feet. These figures have been responsible for some "short-cut" but incorrect reasoning resulting from unfamiliarity with methods for computing costs.

However, the fuel gas cost is but one, and a rather small one, of the factors which make up the cost of cutting. To this must be added the cost of preheating oxygen, cutting oxygen, and labor. The inclusion of these items gives an entirely different aspect to the economy argument. Applying prices to the test data obtained, the total costs show that in cutting clean metal (the most favorable condition for city gas), acetylene proves to be the more economical fuel gas by a slight margin, despite the high unit cost of $0.15 per cubic foot assumed. Assuming a total cost of 100% for oxy-acetylene cutting in each case, city gas costs run 100.1% for ½", 102.5% for 2", and 113.3% for 6" material. For cutting typical billets, however, acetylene preheating shows to marked advantage from the standpoint of efficiency. Again using the 100% base figure for acetylene, the corresponding city gas cutting costs are 145.8% for ½", 127.0% for 6", and 121.3% for 8" material. The above figures consider operating costs only, and do not include such cost items as overhead, investment, and depreciation charges. Nevertheless, they serve to indicate that the claims of savings of 30% or more, made by some users of city gas, are obviously imaginary and must be due to incorrect experimental data or cost computation.

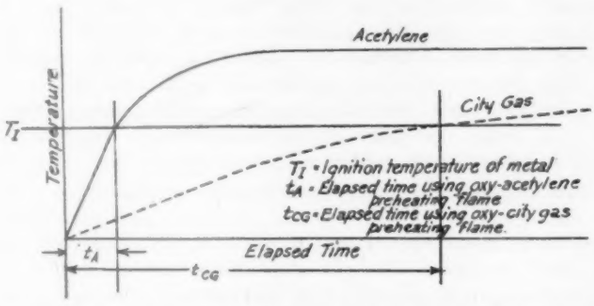
With this variety of tests, no doubt can exist as to the superiority of acetylene over city gas for cutting dirty or oxidized metal. With clean surfaced material, under certain conditions city gas will compare quite favorably with acetylene as to results. However, such conditions rarely occur outside of a laboratory. The normal user of cutting equipment is faced with the necessity of severing material which offers obstructions to a uniform rate of cutting; in fact, a considerable percentage have exceptionally dirty material to cut. There is an appreciable proportion, too, who are utilizing their torches for intermittent work such as rivet or staybolt cutting where the preheating time approximates that required for the cut. The highest possible preheating temperature and the ability to start a cut quickly under all conditions are always of advantage and these desirable characteristics can be obtained only through the use of acetylene.

WHAT SHOP STUDIES SHOW

A statement of the practical aspects of cutting with the two fuel gases, together with some actual experiences, was presented by J. L. Anderson of the National Carbide Company, and the following is quoted from his paper:

Let us analyze carefully and impartially the real operating advantages of acteylene and city gas as fuel gases for cutting, limiting ourselves to consideration of the problem from the shop or operating standpoint, and see if our opinions, as expressed above, are sound and with good foundations.

It is claimed by a public utility gas company, interested in promoting the use of city gas for cutting, that "Great stress is always laid on the intense heat generated by the oxy-acetylene or oxy-hydrogen flame, and the inference is made that this high temperature is necessary in the process



Relative Rate of Temperature Increase of Scale-Covered Metal Surface with Oxy-Acetylene and Oxy-City Gas Preheating.

ordinarily referred to as cutting. Nothing is further from the truth. In no case is it necessary to heat the steel to over 1,300 or 1,400 degrees F. (a cherry red). Red-hot steel will burn in the presence of oxygen just as wood or coal will burn. A piece of steel can be heated over a blacksmith forge and a jet of oxygen will quickly cut or burn it in two without acetylene or other method of heating. What is necessary is the initial heating, and this can be accomplished with city gas as well as with any other means, and, as the cutting or burning progresses, more heat is generated."

Every word of the above is true. However, like many statements made to influence one cause or another, several very important truths that have a very great effect on the final results of the general problem of cutting, have for some reason been omitted.

One of the most important of these truths that was omitted, and which greatly affects the problem, from the shop standpoint, is the fact that, when refractory substances coat the top surface of the piece of steel that is to be cut, which substances themselves will not burn, they must be melted or otherwise removed before the cutting cycle, as described, can be carried out.

Back of all this lies the obvious fact that the actual cutting can proceed only at the rate at which the surface of the material being cut is heated and prepared, by the action of the heating flames through the removal or breaking up of the refractory substances. The fact is that the surface will be prepared at a rate proportional to the differential in temperatures between the heating flames and surface to be heated. Hence, while any method of heating that will raise the temperature of the surface of the steel or iron to the kindling temperature can be employed, it would take a long time to reach a temperature of 1,300 degrees F. in the work if the flame temperature were only 1,300 degrees F., and by the same reasoning, the higher the flame temperature, or, as properly expressed, the greater the temperature differential, the faster the heating operation. The common explanation of this great advantage enjoyed by acetylene, as it is most frequently expressed in the shop, is, that the acetylene flame gives up its heat very readily.

For reasonably good cutting condition, city gas shows good speed, with a satisfactory cut surface, but it shows up very unfavorably when the going really gets to be difficult. For example, in mechanical cutting, if for any reason it becomes necessary to resume cutting in the kerf, where cutting previously has been stopped, it will be found, with acteylene, that it is a rapid and simple operation. It becomes quite a problem with city gas; considerable time is apt to be lost, and the writer has frequently seen cases where the cut should not readily be resumed without starting on a fresh edge, that was not covered with oxide or slag from a previous cut. This, of course, notched the otherwise smooth surface of the mechanically-cut edge. A makeshift arrangement, frequently resorted to, is the breaking of the oxide, mechanically, and where pipes, laminations or other imperfections are encountered below the surface, it frequently becomes necessary to reduce the speed considerably, in order that heat can be absorbed by the material sufficiently to permit continuous operation.

Just a word also about the requirements for the supply of the city gas. At first glance, the city gas propaganda appears to infer that all that is necessary to conduct really satisfactory cutting operations is attachment of the apparatus to any city gas line that is available. Further study shows that, while injector tips are made by several apparatus companies, it is recommended by the city gas advocates that city gas, under pressure, frequently up to about 25 pounds per square inch, be used to obtain the best conditions and results. This either means special lines from the gas company, or, more generally, some sort of booster pump on the property of the company using the city gas. These booster pump installations are by no means simple, fool-proof and non-hazardous. In this connection, its sponsors claim for city gas that it is absolutely safe, and will not explode. Such statements are hardly worth passing notice except to call attention to them as propaganda used by over-zealous devotees, and to point out that all fuel gases must be highly inflammable when properly mixed with oxygen, or they cannot be successfully used for cutting. All such gases will explode, the violence of which will depend on the specific conditions.

In one specific case, all of the following devices were installed in the order stated on the city gas supply line to ensure its safety by the gas distributing company before they were willing to have their customer use the city gas line for cutting:

The 2-inch special supply line, underground. A 2-inch ground plug cock to shut off meter. A suitable low-pressure diaphram meter. A 2-inch ground plug cock to shut off meter. A manometer, with its plug cock. A water seal, a U-tube with drain, shut-off valve, vent, and refilling connection. (This to vent line to prevent pulling vacuum on meter, which would destroy it.) A 2-inch swing check. A motor-driven air compressor adapted to use city gas. A receiver (60 pounds per square inch pressure). A spring-operated unloading valve, to maintain pressure on receiver, and to control intake of gas from main when demand decreased or entirely stopped. A water steal type or flash back arrestor—60 pounds per square inch operating pressure, heavy construction, hard to keep tight, and properly filled with water. A pipe loop, anti-purge device, to trap water from seal, and drain same back to seal. A ½-inch swing check in supply line to stations for flash back prevention. A branch fitting. Lower line to drain moisture. Upper line to regulator. A globe valve. A gas regulator.

This is surely an interesting collection of apparatus to maintain. The electrical equipment, belts and compressor itself have not been mentioned in detail.

While considering this subject of pipe lines for city gas, let us quote again from the statement of one of the gas distributing companies who are trying to develop the use of city gas for cutting. They say, "All of these were supplied from high-pressure distribution mains and the gas for cutting was piped direct from the meter at a pressure of approximately 25 pounds per square inch. This meant that a two-inch pipe was large enough for all the yard piping necessary for the cutters, as each torch used but a very small amount. A two-inch pipe 1,000 feet long, with but a pound or two drop in pressure, was of sufficient capacity to operate twenty torches simultaneously."

May we point out that with acetylene and a 12-pound intial pressure, 20 torches would produce a negligible drop on 1,000 feet of two-inch pipe, which is the largest size required for pressure for acetylene distribution, except for the very largest installations.

With city gas, cutting can be carried on only in those areas supplied with suitable pipe lines. The extent of this handicap is quite apparent, when the problem of getting the gas to the scattered jobs is tackled in the average large manufacturing plant, and if gas welding is also to be carried on, there are required acetylene pipe lines, or the ever-present and exceeding handy and portable dissolved acetylene cylinders. Such handicaps are bound to be recognized, and will influence the use of city gas for cutting.

It is well known and quiet generally recognized that to secure the maximum results from any cutting process, the pre-heating flames must be kept adjusted, so they are uniformly neutral or oxidizing, as the case may be, for the job in hand. Even when using acetylene with its distinctive flame color, it is sometimes difficult to see the flame while the cutting is actually in progress, and to make sure that the adjustment is correct or that it has not changed. City gas, burning freely with oxygen, has a less distinctive color and appearance, and with the loss of color that takes place in the presence of the light and heat of the actual cutting, the city gas flame cannot be seen at all. The seriousness of this condition may not be apparent at first glance, but, when doing accurate work with machine torches, where every effort is made to produce good quality cuts, this apparently slight defect assumes considerable magnitude.

Without any question, the one single item of major importance in any group of claims that are made to arouse the interest of any prospective purchaser of any commodity, is the one claim of lesser cost.

Without doubt, therefore, this claim is the one that is stressed the most by the sponsors of city gas cutting.

To prove it, tests are cited that purport to show the advantage of city gas cutting from a cost standpoint.

Carefully run tests do not show this claimed saving when city gas is used for the fuel gas. In all shop tests that are to all intents and purposes very carefully and accurately conducted, there are elements that cannot be correctly recorded or observed or controlled that nullify and so affect results, that the apparent results are untrue and unreliable.

This discussion is not intended to be an indictment of city gas for cutting operations, but, rather, to point out the pitfalls that lead to false impressions and reactions.

Perhaps we can get a general over-all picture of the conditions existing today in the shops making use of the processes of our industry, if we briefly review statements regarding the experience of various companies who have recently used city gas for cutting.

(The author here introduced reports of twenty-six users of the gas cutting process who had tried city gas. Thirteen claimed city gas to be cheaper. Seven of the others thought acetylene the more economical, and the remaining six had returned to the use of acetylene.)

A study of the above examples, brings out several interesting points. In practically every case where city gas cutting is satisfactory, cuts are being made on new, clean metal. In none of the cases has it been possible to obtain actual costs, but it seems probable that some of the estimated savings are exaggerated, and if accurate records were kept, the economies might prove to be non-existent. Slow cutting time was given as a major reason by five of those who rejected city gas cutting, and this factor is also admitted by four of those who are using the process. Increased oxygen consumption was given as the reason for two rejections, and seven of those who are using the process, admit an increase.

In conclusion, may we add the following, lest we be considered biased on account of business affiliations?

In one shop test recently conducted on a rather more extensive scale than usual in which shop operating conditions had been established for oxy-acetylene cutting on the basis which required quantity production at reasonably safe and economical speeds, city gas competed on the same production schedule and established speeds. The result was, in the main, favorable to acetylene from every angle. Subsequent efforts to prove the record set for city gas in this case have resulted in a less favorable record, and generated acetylene has been retained as a fuel gas for this shop.

To all who feel they must prove to their own satisfaction the relative merits of illuminating gas and acetylene as fuel gases for cutting, let me suggest that the answer as to which is the most economical will not be found in the cost of the fuel gas and oxygen which flows through the torches during a specially staged test, but in the accounting room, where every factor that enters into plant operating costs for a given period is carefully computed.

G. P. A. PROGRAM FEATURES INTERESTING PAPERS ON OXY-ACETYLENE PROCESSES

Announcement has been received that the fourteenth mid-winter meeting of the Gas Products Association will be held at the Palmer House, Chicago, January 26th to 28th. A general invitation to attend open meetings has been extended to the industry, and it is evident, that attendance will be worth while, from a study of the interesting papers which have been arranged for the program.

Thursday Morning, January 26, 1928, 10:00 A. M.
Open Meeting

Registration.

Address of Welcome—Bernard J. Mullaney, Vice-President, Peoples Gas, Light & Coke Co., Chicago, Ill.

Roll Call—A. J. Russell, Secretary and General Manager, Bettendorf Oxygen Hydrogen Co., Betterndorf, Iowa.

President's Address—C. O. Epperson, Vice-President and General Manager, Compressed Gas Corp., Denver, Colo.

Report of Secretary.

Report of Treasurer.

Atomic Hydrogen Welding—W. M. B. Brady, Welding Specialist, General Electric Company, Chicago, Ill.

Thursday Afternoon, January 26, 1928, 2:00 P. M.
Open Meeting

Generating Acetylene on a Large Scale at Shawinigan Falls—R. A. Witherspoon, Vice-President and General Manager, Shawinigan Chemical, Ltd., Shawinigan Falls, Can.

Welding and Brazing Monel Metal and Nickel—C. A. Crawford and J. G. Schoener, International Nickel Co.

Generation and Compression of Acetylene in a Modern Plant—R. H. Sullivan, Engineer, Acme Oxy-Acetylene Company, Chicago, and C. V. Moody, Engineer, Purox Company, Los Angeles, Cal.

Building Up Battered Rail Ends—E. G. Luening, Vice-President, Kentucky Oxygen Hydrogen Company, Louisville, Ky.

Friday Morning, January 27, 1928, 10:00 A. M.
Open Meeting

Welding Pipe in Industrial and Office Buildings—Speaker to be announced.

Welding in the Heating Industry—G. W. Macauley, Manager, Grand Rapids Welding Supply Company, Grand Rapids, Mich.

Locomotive and Car Repairs Made by Bronze Welding—G. M. Calmback, General Welding Supervisor, Wabash Railroad, Decatur, Ill.

High Quality Welding—Dr. A. Krebs, Treasurer, General Welding & Equipment Company, Boston, Mass.

Friday Afternoon, January 27, 1928, 2:00 P. M.
Open Meeting

Experiences of the North Shore Gas Company in Welding High-Pressure Gas Lines—J. G. Hart, General Manager, North Shore Gas Co., Waukegan, Ill.

The Fabrication of Steel Plate for the Production of Machine Bases, Frames, Etc.—John J. Kutscheid, Kutscheid Mfg. Co., Chicago, and H. P. Ritsch, Welding Engineer, Chicago, Ill.

Financing Film No. 3—E. L. Mills, Sales Manager, Bastian-Blessing Company, Chicago, Ill.

Technical Papers as a Means to Develop and Promote Welding—H. S. Card, Managing Editor, Welding Engineer, Chicago, Ill.

The Gas Welding and Cutting Flame and Its Value—Stuart Plumley.

Saturday Morning, January 28, 1928, 10:00 A. M.
Open Meeting

How Can the Quality of Caustic Potash Be Determined Prior to its Use?—C. W. Brown, Manager, Innis Speiden & Co., Chicago, Ill.

A Discussion of Methods for Quinquennial Testing of Purging Bottles, Dry Battery Bottles and Other Cylinders Subject to High Pressure Other Than the Regular Shipping Cylinders—E. G. Luening, Vice-President, Kentucky Oxygen-Hydrogen Co., Louisville, Ky.

Should Oxygen Be Chemically Dried Before Compressing Into Cylinders?—J. T. Butler, District Manager, Burdett Oxygen & Hydrogen Co., Pittsburgh, Pa.

Discussion of Oxygen Plant Operation With Special Reference to the Prevention of Freeze Ups—W. F. McKay, Chief Engineer, International Oxygen Company, Newark, N. J.

Measuring Oxygen Gas By Weight—E. G. Luening, Vice-President, Kentucky Oxygen-Hydrogen Co., Louisville, Ky.

Apparatus Group Meeting

Apparatus Group Will Meet in Room No. 11 to Discuss Matters Pertaining to the Apparatus Industry—A. J. Fausek, Chairman, Modern Engineering Co., St. Louis, Mo.

Saturday Afternoon, January 28, 1928, 2:00 P. M.
Closed Meeting

Saturday Evening January 28, 1928, 6:30 P. M.

Informal Dinner and Entertainment.

NEW CUTTING AND WELDING HANDBOOK

A handbook on cutting and welding with gas, especially adapted for shop use, has been prepared by Mr. F. A. Bullock, manufacturing engineer of the American Locomotive Company. The author has worked out a method which has resulted in a very material saving in oxygen and acetylene and maintenance cost on apparatus and has prepared the annual which foremen use as an instruction book when conducting weekly classes for their men. It is stated that economies resulting from the conduct of these classes have been as high as 40 per cent. The manual has been prepared in loose-leaf form and is being offered for sale in a standard pocket size, leather, loose-leaf ring binder, which allows the insertion of extra pages if desired. The text explains the principles of cutting by the oxy-acetylene torch and the oxy-acetylene welding operations. Particular attention is given to the fundamental principles of operation, rather than specific jobs. The portions of the text which are especially intended to produce economy in operations are those devoted to care of the different pieces of apparatus, the handling of cylinders and general operating rules which lead to economies. Tables showing tip sizes and pressures for various thicknesses of metal are given in the appendix. In all there are 48 pages of 3½x6 inch size. The price is $7.50 per copy with discounts for quantity orders. The publishers are Morrill and Morrill, 30 Church St., New York City.

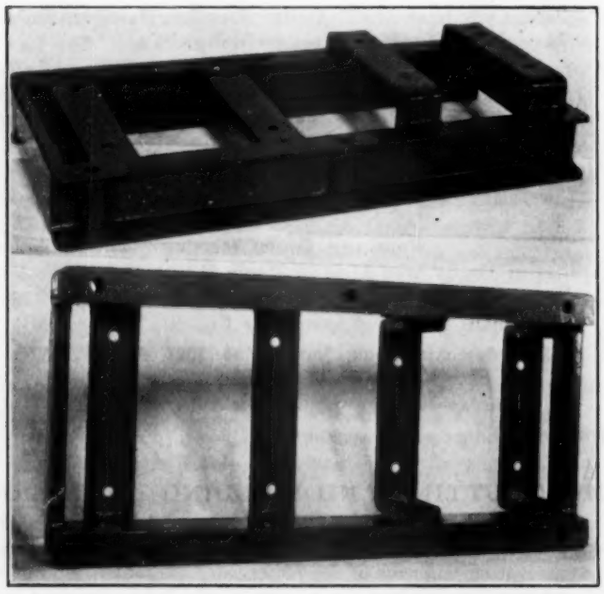
Give Welds Finished Appearance*

Saleability of Welded Articles Will be Increased if Welds Are Properly Placed and Properly Finished Instead of Left Rough

By C. H. Hollup†

MUCH has justly been said and written on the technical phases of welding, particularly relating to the physical properties which may be expected from a weld made under the average shop conditions. As a result, a wealth of information and data is available to the public on technical considerations of welding. Therefore the subject of this paper, which deals with appearance, or what might be called the "artistic" part of welding, was chosen to avoid repetition and also to emphasize a factor in fusion welding which has been much neglected. We are going to confine our remarks to those characteristics which fusion welds must have if they are to sell themselves to the general public.

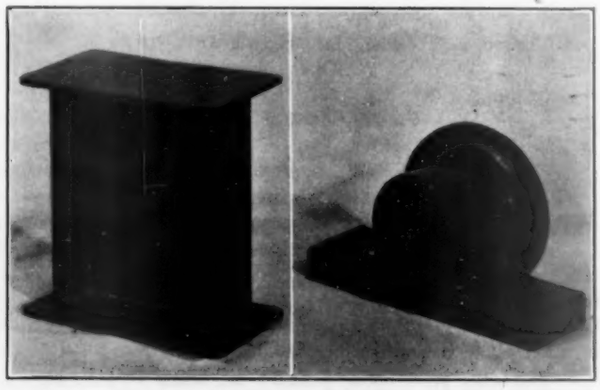
It should be realized that the ultimate consumer of welded articles is going to be the final judge of the increase of welding applications. His acceptance or rejection of the idea of using welded articles will determine the progress of fusion welding in the future. It will pay us, therefore, to analyze those characteristics of fusion welding, which influence the impression made on the average users of welded articles. In this discussion we must remember that such users will be both men and women of many different classes; some of them plain business men; some of them engineers; some of them mechanics; some of them just plain home people. In fact, there will be representatives from every type and class of occupation among the users of welded articles.



Welded Machine Base; Dimensions to Order, Without Expensive Patterns. Bottom View Shows Design and Method of Placing Welds to Get Best Appearance.

This is particularly true now that fusion welding is being used in the production and assembly of new machinery, furniture and equipment of all kinds. There is a concern in Chicago, which has adopted fusion welding to the fabrication of frames for woodworking machinery. Others are using standard structural steel shapes in the fabrication of machine bases, which were formerly made of cast iron; still others are using welding to manufacture furniture and ornamental stands, etc. It is reasonable to expect that in the near future welded articles will find their way into every home, office and factory and into all units of transportation, including automobiles, railway coaches and street cars. At least this is our hope and endeavor. To make this dream come true, we must analyze the product and the process that we are offering to make them as perfect as possible, from every view point.

The several factors of a fusion weld, which would be scrutinized by the average user, would be fitness for the job, strength of the weld, economy of making it, (as compared to previous methods) and its appearance. It is difficult to list these factors in the order of their importance because this order would change for the different applications. In many cases the appearance would be the most important factor and in others the economy would be the most important, whereas in some, the main consideration would be the strength.



Two Channels and Three Plates Make the Machine Stand. The Bearing (at Right) Is Made from a Piece of Plate, a Piece of Pipe and a Washer. The Unusually Smooth Appearance Is Easily Obtained.

Under "fitness for the job" should be considered, whether or not the article should be welded at all. In some cases, where machinery has to be taken apart and shipped "knocked down," or where a certain part wears out rapidly and must be replaced, it should obviously not be welded.

The factor of strength is the one that has apparently been given the most attention and a great deal has been written on this subject. Many tests and experiments have been made to show how much strength and ductility fusion welds have. In fact, so much attention has been directed towards this one characteristic, that it has almost assumed undue proportions. In the majority of cases, two parts that are welded together are twice as strong as two parts that are riveted together and yet this factor of weld strength has worried a great many people and caused a great deal of discussion and comment. However, during the past few years, so much of this experimental work has been done, and so much published about it, that it is becoming generally recognized by everybody, even including those not directly in touch with welding, that a welded job is safe and durable, if properly designed and made.

A great deal of work has also been done to prove that welding is economical as compared to other methods. In general,

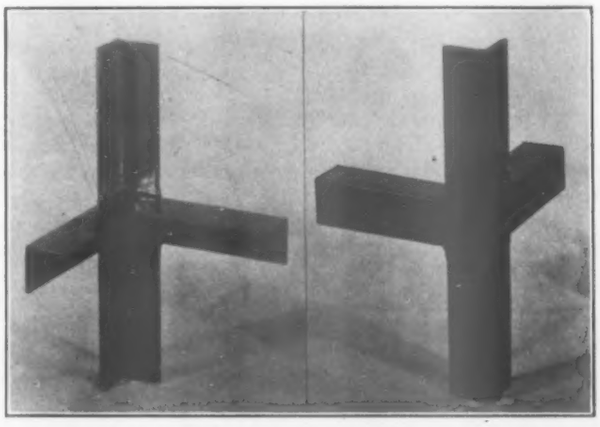
*Paper read before American Welding Society, Chicago Section, Jan. 6, 1928.

†Vice-President, C. H. Hollup Corporation, Chicago.

we would say that this factor should be carefully studied for each application and due consideration should be given to the service that the welded article is to perform after it is completed. In other words, we should not become over-enthusiastic about using welding everywhere and every place just because we are interested in welding. There are some few cases where it is more economical to use some other method, such as rivets or bolts, and those of us who are concentrating our time and energy on welding, must be careful to keep this point in mind. We should help those who are considering the adoption of welding in their processes to give each factor its due consideration in their preliminary investigation. If welding is to progress, as it should, its progress must rest on the firm foundation of facts and not on assumption or sentiment.

We now come to the factor of appearance, as relating to fusion welds. You have often heard the remark "that is a very smooth looking weld." We venture to say however, you have never seen a real smooth weld made by any one of the fusion processes unless it was made with a mold. Of course some welds are smoother than others and the operator has a great deal to do with the appearance of the welds, as we know them. However, except to those of us who are continually in touch with fusion welding, both electric and gas welds do not appear smooth; on the contrary, they appear rough.

For this reason, when welding is considered as a method of joining parts for certain classes of equipment or machinery, where good appearance is an important factor, it will pay the manufacturer of such equipment to dress up the weld to give



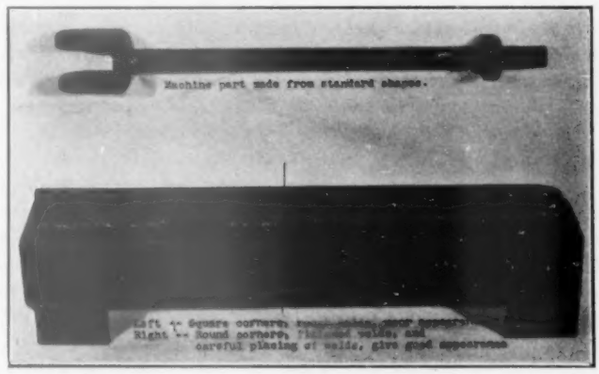
Two Views of Joint in Steel Furniture. Note Simple Design and Smooth Appearance.

it the same smooth appearance that would be obtained by using a casting or some other conventional method.

In this connection, we must realize that the application of fusion welding at the present time, is during an age when appearance and looks are receiving more attention than ever before. Notice the architecture of modern buildings and compare it with buildings erected, for similar purposes, fifteen or twenty years ago. You will then realize how much attention is given to the subject of looks. This is not only true of buildings, but is true of machinery, furniture, automobiles, clothes, magazines and everything influenced by public opinion.

Considering these facts, why should the matter of appearance and looks be overlooked in fusion welding? Why should we expect fusion welds, in their naked state, to be received with open arms of approval by those who are not intimately acquainted with it. It is a peculiar human characteristic to be governed more by looks than by actual value. This is especially true on first acquaintance; so that the man to whom you are trying to sell a welded article, or to whom you are trying to sell a welding machine, with which to make a welded article, is undoubtedly prejudiced against welding immediately when he sees his first sample. He will probably say, "Why that looks terrible, I wouldn't put anything like that on my machines. Nobody would buy them," and he is more right than wrong.

Those of us who are intimately connected with the welding industry get so accustomed to the look of fusion welds that we think they are fine, but if we stopped and analyzed the matter from the viewpoint of the outsider, we would realize that there is room for great improvement. This does not necessarily hold true for all welds, but the point is, in certain cases it is true and these certain cases may have far reaching effects. This is for the reason that the same executive who had to be sold on appearance before adopting welding



The Top Picture Shows What a Welder Can Do With Standard Steel Shapes. Below Is a Contrast of Unfinished and Finished Welded Product.

for his product, would later, because of his acquired confidence in the method, authorize the welding of his new steel building. If all of us were to concentrate a little more on appearance of fusion welds, we should do a great deal towards assisting in the more rapid acceptance of the process in all industries.

Now the question might be asked, "What can we do in order to improve the appearance of these welds?"

First, comes the matter of design, which includes the location of welds and the shape of the parts to be welded. In many cases welds on assemblies of machine bases, machines, etc., are in plain sight when they could just as well be out of sight. It is usually just as easy to weld underneath a cross channel section, which joins other members, as it is to weld on top of the channel. Some of the illustrations show what is meant by this. The first consideration, therefore, is to design the assembly with the object of locating the weld where it will be out of sight wherever possible.

The next important method of taking care of appearance in welded assemblies is in the design of the mechanical parts that make up the assembly. For instance, a little time should be spent to round off corners and produce curves where possible. Round corners, round edges and curves are always more pleasing to the eye than sharp corners and sharp fillets. We are not going into the psychological reasons for these facts but they are the result of a great deal of experience and when our attention is directed to them we know they are true. Therefore, in the matter of design and original layout, two points should be kept in mind, and that is to lay the job out so as to keep the welding out of sight as much as possible and the other is to form the parts entering into the assembly with rounded corners and curves, instead of sharp corners and angles.

The third important thing that can be done to improve appearance of fusion welds is to smooth the weld itself. This can be done either by mechanical methods or by applying a finishing substance. The welds may be ground off or smoothed off by filing, etc., and in many cases this has been done in the past. It is obvious, however, that this smoothing off

could usually be better and more economically accomplished by other methods. In the first place, grinding generally requires special grinding tools because many welds are in inaccessible places and the weld cannot be taken to the ordinary grinding wheel. Therefore the wheel must be on a flexible shaft and of small diameter in order to get to these difficult places. Another thing to be considered is that grinding removes metal and therefore reduces the strength of the weld which should be avoided if possible.

We suggest, as a quicker and more economical method, the use of a filler compound which can be rubbed over the weld before painting. This is the same process commonly used in the finishing of ordinary castings and the method is accepted as good practice for such purposes. Is not an electric or oxy-acetylene weld a casting? If so, why shouldn't it be treated as any other casting that has a rough surface? Please understand that we are only talking about welds where good appearance is necessary and desirable.

Machine builders have long recognized the importance of appearance and they practice extreme care in covering up slight defects in castings, such as blow-holes, fins, scabs, sharp corners and other defects, by filling up such holes and uneven spots with machine filler and paint, or by grinding. Why then, is it the almost universal practice of welders, or people who turn out welded work, to leave the weld in its crude state without spending any time to clean it or smooth it off. Why try to force the other fellow, who is not accustomed to such crudeness, to like it? Perhaps you have heard it said that some people do not care to change over to welding just because their product would not look as good when welded, even though considerably cheaper to make. Therefore, where good appearance is important, it should be our aim to conceal fusion welds by careful design, or smooth them by grinding, or by using a suitable filling compound and then painting.

Filling compounds, which are suitable for dressing and finishing fusion welds are on the market; they are cheap, they are easily used and they are efficient. In other words they form a durable, lasting, smooth finish to which paint adheres readily. The cost of applying this finishing compound is very little, yet there is all the difference in the world between a welded assembly which has been dressed and finished with this compound and one that has not. The accompanying illustrations clearly show the difference. They are photographs of welded products finished with our own compound for this purpose, which we call "Smooth-Ize."

As an illustration, notice the model of a machine base which is all welded. It is merely a suggestion as to how larger bases might be constructed by welding and still retain their conventional appearance. It can be seen that the entire piece is made up from standard stock material, such as channel iron angles, plates and common black pipe. This model shows how two different sized machines, for instance a motor and a pump, can be mounted and made a self-contained unit. It is easy to move on rollers or skids, or lifted at the ends with a crow-bar or jack screw when leveling. It can be permanently bolted down to a concrete foundation and is easy to grout in with cement after leveling. By placing a sheet iron pan between the side frames, which would be easily removable, the whole unit can be kept clean and free from oil or dirt. This welded form is especially adaptable to individual cases, because no costly pattern is required. This base is made entirely of standard stock material without any patterns or castings, and the only machine tools required were an arc welding machine and a drill press. It costs less, weighs less, is made in less time than it would take to make the pattern alone and is much stronger than a cast iron base. Finally, because of the hidden welds, its rounded corners and the use of "Smooth-Ize" filler, its finish and appearance is pleasing to the eye.

The slight additional cost of properly finishing fusion welds, by using a filling compound might be objected to by some, but it should be remembered that the additional cost will pay for itself many times over. It is not just sentiment that causes people to put up good looking buildings, or buy neat well made clothes; or in general, to prefer things that have a good appearance. This preference is based on a more modern knowledge of human nature and economic facts. Some would call "good appearance" advertising, some "creating good will," but regardless of what you call it, the effect is to produce complete satisfaction and if our welds do not give complete satisfaction, we are never going to see fusion welding make the progress that it should.

We believe, therefore, that all concerned with the application of fusion welding can render invaluable service toward the increased use of welding if more attention is given to the good appearance of welded articles where good appearance is an important consideration.

MUELLER BRASS COMPANY ANNOUNCES STOCK SUBSCRIPTION PLAN TO EMPLOYEES

An interesting example of the modern tendency of manufacturers to encourage the habits of thrift and systematic saving among their employees, is shown in a recently announced stock subscription plan, originated by the Mueller Brass Company, Port Huron, Mich., under the direction of O. B. Mueller, president and general manager.

Principal among the provisions of the plan are:

1. That all employees who had been in the service of the company one year at the time the plan went into effect, receive as an outright gift from the company, as a token of appreciation for their services and loyalty, one share of 7 per cent cumulative preferred stock.

2. That the company will offer each employee, who qualifies as to service, the right to buy additional stock in amounts not to exceed 10 per cent of his annual earnings, exclusive of bonus payments.

3. That such stock may be purchased by the employee outright, or on monthly payments to be deducted from the purchaser's pay.

4. That the company will deposit each year from 1929 to 1933 inclusive, a percentage of its profits in the form of a trust fund which will be distributed pro rata in January, 1933, to all employes stockholders who have remained in continuous employ of the company and who are at the date of the disbursement still in possession of their stock.

5. That the company agrees to re-purchase at par value upon ten days' notice, any stock thus sold previous to the division of the participating trust fund.

6. That suitable provision be made to protect employees' stock investments in the event of temporary unemployment, sickness or death.

The stock that is being sold under this plan is preferred and cumulative, having preference over all other classes of the Company's stock with respect to assets and dividends. Paid up stock, deposited with the Company, will entitle any employee to a Company loan not to exceed 90 per cent of the stock's par value.

CENTRAL STEEL AND WIRE HANDLE NATIONAL CARBON PRODUCTS

Announcement has been received that the Central Steel and Wire Company, Chicago, Illinois, makers of "Swedox" welding rods, wire and electrodes, have been appointed distributors of the products of the National Carbon Company, Inc. These products include not only carbon electrodes for carbon arc welding and a special line of graphite electrodes, but a complete line of carbon rods, blocks and paste used for shape welding and mould welding.

Welding With "Electronic Tornado"

New Process Adapted to Automatic Carbon Arc Welding Has Produced Weld Deposits of Unusual Characteristics—Said to Be Low in Operating Cost

FURTHER developments of the Electronic Tornado which was discovered in the Research Laboratories of the Lincoln Electric Company, Cleveland, Ohio, about twelve months ago, have produced results which it is claimed will revise present ideas as to the ductility, strength and cost of welds made by electric arc welding. This new process, based upon an electric phenomenon which was originally considered as of only scientific interest, has been further developed so that its commercial application is considered assured. This "electronic tornado" is applied to carbon arc automatic welding machines.

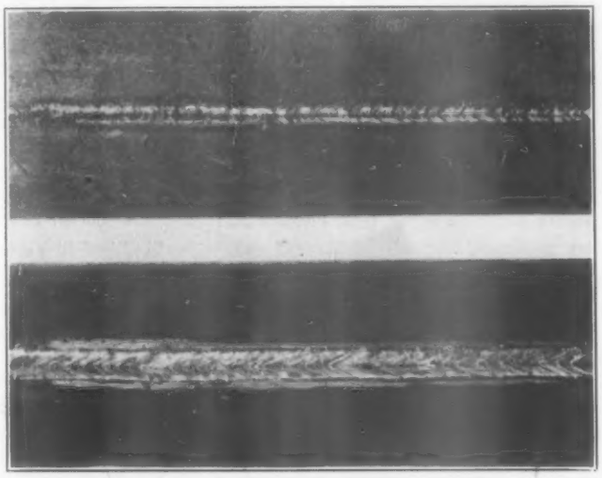


Fig. 1—Metallic Arc Weld Above. Electronic Tornado Weld Below.

The electric arc is normally a difficult phenomenon to control. It creates its own magnetic field and the passage of the welding current through the parts being welded creates magnetic fields of variable direction. The arc, therefore, tends to wander around seeking the path of least resistance between its own magnetic field and the field produced by the passage of the welding current through the piece being welded. By superimposing a strong magnetic field on the arc flame, the new control permits the arc to travel through variable fields without disturbance. This magnetic control appears to give the arc a gyratory motion and the controlled arc has been called an

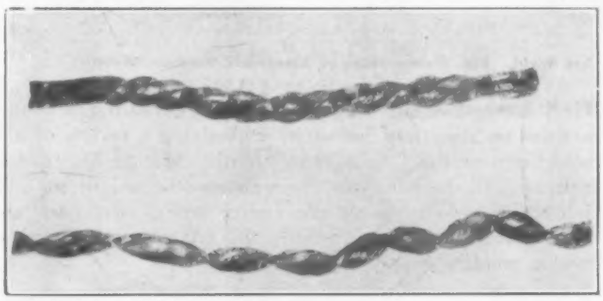


Fig. 2—Test Welds with Electronic Tornado Twisted Through 1080 Degrees.

"electronic tornado," the magnetic field apparently giving a swirling or gyratory motion to the electrons in the arc.

Not only are the welds produced by this new process uniform in structure and ductility, but the cost of welding is expected to be considerably reduced. For example, the cost of welding ½ in. plates, including operator's time, electric current and carbon electrode, is estimated at a maximum of three cents per running foot of weld. The cost of welding plate of other thicknesses is expected to be proportionate. While it is not thought at the present time that the Electronic Tornado will affect the manual arc welding process it is predicted that all sorts of equipment which can be welded automatically will be materially decreased in cost. Freight cars, oil cars, oil storage tanks, pipe lines, box girders for buildings and similar products

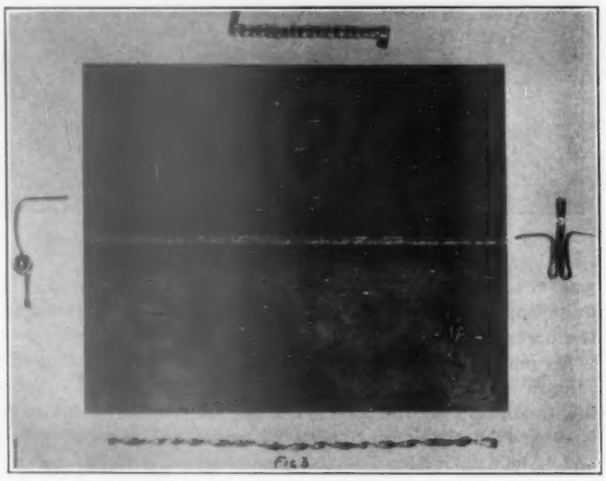


Fig. 3—Electronic Tornado Weld in 16-Gauge Metal.

are among the possibilities named for its application.

Heretofore metal deposited by electric arc welding has partaken of the characteristics of cast steel. By this new process the metal deposited in the weld shows equal or even better physical characteristics than the metal of the plates joined by welding. This is said to be a result of the purifying effect of the electronic tornado.

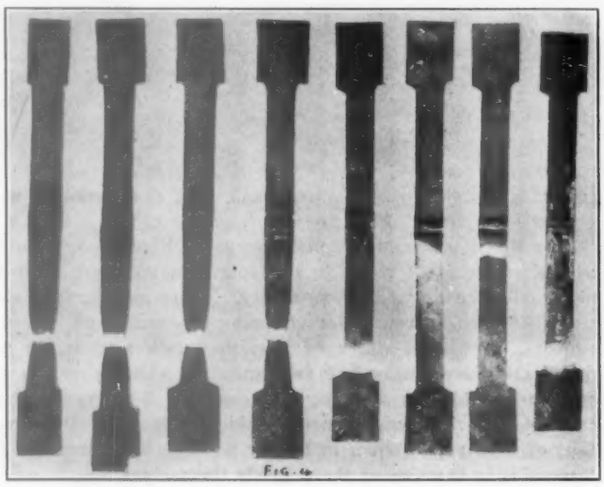


Fig. 4—Test Bars from 10-Gauge to ½ Inch.

The test pieces in Figure 2 are electronic tornado welds on ¼ and ½ in. plate. The welds were sawed from the plate and the resultant bars were twisted through 1,080 degress or three complete revolutions without showing any indication

whatsoever of failure. In Figure 3 bars cut from welds were twisted cold and tied into knots without any sign of fracture. In Figure 5 welds on heavier plates are shown and bending and twisting tests are illustrated which indicate unusual physical qualities in the weld metal. Figure 4 shows a series of test bars subjected to tension tests. Of the many tests of this kind there

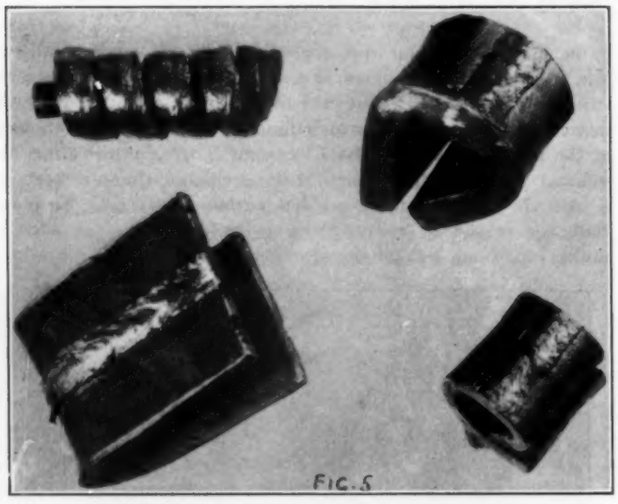


Fig. 5—Tests of Strength and Ductibility.

was not a single failure in the weld or near the weld. It is quite apparent that there is no impairment of the strength of the parent metal by the new process.

An incidental advantage of electronic tornado welding is the smooth finish which is obtained on the welding bead. According to officials of the Lincoln Electric Company, this in part is caused by the higher speed of travel of the welding heads and is in part inherent in the new process.

"As a generality, the structure of this new process sample is very similar to that of a highly refined low carbon steel, a condition brought about in such steel by a suitable heat treatment.

"Within our experience on welded metals, we have never seen a structure such as this in the filled-in metal, and it is our opinion that this structure suggests physical properties which should very closely approach those of the parent metal.

"Actually an electronic tornado weld is heat treated steel and for that reason is entirely free from undesirable hardness. Its great ductility is evidenced by all the test pictures in the accompanying illustrations. The refining effect of the new welding process produces weld metal fully as good as that that can be obtained in rolled steel of the same general purity."

AIRCO BOOKLET DESCRIBES BARREL WELDING

A booklet entitled "A Study of Oxy-Acetylene Welding as Applied to Light Gauge Pressure Containers," by H. J. Grow, is being distributed by the Air Reduction Sales Company. The booklet is in effect a reprint of a paper presented by Mr. Grow at the last Fall Meeting of the American Welding Society. In particular, it is a study of the forces set up by expansion and contraction of thin gauge metal when welded and the methods that have been found to counteract welding difficulties. In calling attention to this booklet, Mr. F. E. Rogers, Publicity Manager of the Air Reduction Sales Company, very aptly points out that when it is known that over 600,000 oil barrels are produced monthly by the various barrel manufacturing concerns in the United States, it is quite evident that this is an important field for welding.

ASKED TO FILL AUTHOR'S ROLE

J. Linn Johnson, of Wilkes-Barre Welding Co., Wilkes-Barre, Pa., has received a letter from International Commerce, a review of British, foreign and overseas trade, of 32 White Hart Lane, London, England which is preparing a series of articles on American industries embodying a review of a few selected concerns. As a representative firm in his sphere of activity, Mr. Johnson, who is registered as one of the oldest job welding concerns in the United States, has been asked to prepare a series of articles on difficult, interesting and unique welding operations.

Fig. 6—Structure of Common Steel Plate. Fig. 7—Structure of Metallic Arc Weld. Fig. 8—Structure of Electronic Tornado Weld.

The group of photographs shown in Figures 6, 7 and 8 are micrographs of common steel plate, metallic arc weld and electronic tornado weld, respectively. These micrographs show the difference between the common arc weld and the new process. It will be observed that the grain size in the new process is exceedingly fine and uniform, whereas in the metallic arc weld it is irregular and coarser. The crystal structure of the electronic tornado weld is almost identical with that of mild steel shown in Figure 6. The only practical difference is in the size of the crystals themselves.

Commenting on these micrographs the metallurgist who made them reported, "Comparing the new process structure to that of the raw steel, you will note that these structures are generically the same, the grains being more or less rounded in general contour.

OWEN ARC WELDER WORKS ON INDUCTION PRINCIPLE

Frederick C. Owen, a prominent electrical engineer of the South, is the inventor and patentee of the new Owen Induction Welder, which is manufactured by the Owen Electric Manufacturing Company, at Fayetteville, North Carolina. The economy and convenience of alternating current arc welding

has for years been a subject of study by electrical engineers, and many machines have been put on the market for the purpose of obtaining a satisfactory welding arc with the low cost alternating current power. In 1911, Mr. Owen began to devote his entire attention to electric welding and after a period of experiment determined that the proper current to maintain an alternating current arc would necessarily be one in which a slow reversal of the frequency could be overcome to a great extent. He endeavored to accomplish this with the resistance type devices at first but the results were not satisfactory to him. He then started working toward perfection of a transformer design which would produce an arc having the proper welding though large enough to carry a reasonable overload. In 1924 Mr. Owen's efforts were finally successful, leading to the construction of an ingenious machine for transforming alternating current to welding current by induction.

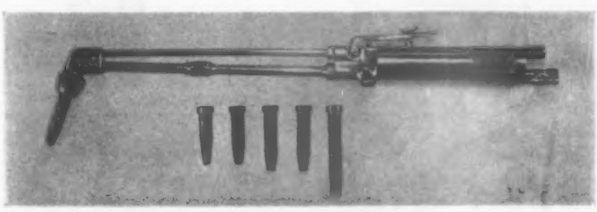
During the last three years attention has been given to the improvement of the apparatus and in a recent interview, Mr. Owen stated that he believes he is building an arc welder which meets every welding requirement. Features claimed for the machine are: a constant low voltage across the arc, a magnetic

F. C. Owen

pull through the arc, facilitating ease and speed in welding and obliging the operator to hold a close arc. It is also claimed that the machine is free from overheating. The manufacturers have a general distributing office for the United States and Canada located in the Woodmen of the World Building, Omaha, Nebraska.

A NEW LIGHTWEIGHT COMBINATION CUTTING AND WELDING TORCH

The Alexander Milburn Company, Baltimore, Md., manufacturers of welding and cutting apparatus have recently de-



New Lightweight Milburn Combination Torch

veloped a new light-weight torch which cuts or welds with the mere interchange of tips. It is made to operate with either oxygen and acetylene, oxygen and hydrogen or other gases.

This torch, known as the Milburn Type RI, has all the salient features of the well-known Milburn Combination Cutting and Welding Torch, Type NI. This latter is a two purpose torch, cutting or welding the lightest or heaviest metals within range of the process by a mere change of the tips. It obviates the necessity of using two torches, also of disconnecting hose from the torch valves when changing from cutting to welding operations or vice versa.

The Milburn Type RI Torch is extremely light in weight for the wide range of work it is said to perform, weighing only 40 ounces. This weight is advantageous to the operator for continuous work. The torch efficiently cuts or welds by a change of the tips, welding light or heavy metals and cutting upwards of 12 inches in thickness.

Some important features of the light-weight combination torch are: The torch has only two gas tubes (made of stainless steel); the high-pressure cutting oxygen thumb button which remains fixed in either open or closed position without sustained pressure from the thumb; the forged bronze torch head and valves having a tensile strength of 60,000 pounds per square inch; designed for strength for severe work and for lightness for continuous operations; it uses the heat to the best advantage while affording protection to the hands of the operator; all valves readily accessible; well balanced; easy to handle; and the supermixing of gases resulting in a neutral, uniform flame as well as the elimination of flash backs.

ACETYLENE SOLDERING TORCH

The oxy-acetylene flame provides an easily manipulated source of intense heat which is used in welding and other heating operations where extremely high temperatures are required. There are, however, many other industrial heating applications, such as soldering and brazing, where a lower flame temperature can be used to advantage. With burners designed for the admixture of atmospheric air, acetylene alone will give a flame hot enough for many purposes.

The small gas tanks that have for years been almost universally used for truck and motorcycle lighting have also found many applications in the industrial field.

An inexpensive outfit has been developed consisting of a light blowpipe handle and a set of special tips giving flames suitable for a wide range of work. The outfit is most conveniently used with a small gas tank, the same as is used on a motorcycle or truck, and a 6-foot length of hose.

Acetylene Soldering Iron.

Small furnaces for heating lead, paraffine, and the like are also manufactured.

Acetylene has distinct advantages over liquid or other gas fuels. It not only produces a higher flame temperature than gasoline and coal gas or natural gas, but forms a flame that is non-oxidizing and non-carbonizing and can be perfectly controlled. Fire hazard is reduced since no liquid fuel is required.

An outstanding advantage of the outfit is its complete portability and it gets into action immediately. No preheating is required. It is necessary only to turn on the gas, light the torch, and the job is under way. The gas can be turned off between jobs.

Charging plants supply gas exchanges through jobbers and distributing stations throughout the country. But a moment is required to trade an empty tank for a full one. Only the gas content of the cylinder is paid for since no rental charge is made for the use of tanks.

Soldering may be done either with one of the tips, or the blowpipe may be converted into a soldering iron by slipping the soldering copper over the end of the blow torch tip and tightening a single set screw. It can be maintained at the right temperature by the internal flame. Work does not have to be stopped to reheat or change the iron.

The unit is especially liked by electricians for work on poles or underground or in any inaccessible place. It works equally well in any position and can always be lighted without inconvenience.

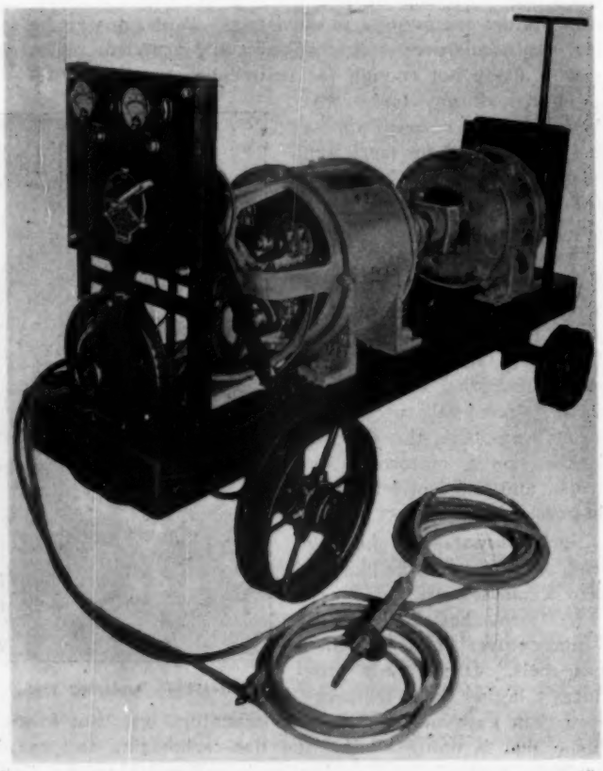
In plant maintenance and production processes, where even slight delays are costly, the high temperature flame is found to do the work faster than other heat sources and time spent in preheating and refilling with liquid fuels is saved.

NEW FEATURES ON WILSON STANDARD TYPE "S" WELDERS

The Wilson Welder & Metals Co., Inc., Hoboken, N. J., announce several new features on their Standard Type "S" Welders.

There are no live connections on the front of the control board—the main switch is enclosed and mounted on the back of the board and only a dial and pointer appear on the front. The reactor is underslung and is so placed over the rear axle that it is protected from injury.

A new feature of the "S" control is a rotary switch, designed



New Wilson Type "S" Welder.

to give close welding regulation, which is so much in demand by repair companies, who have to guarantee their work, and in productive work such as in the automotive field. And for those who want speed, with large electrodes and heavy current, it is claimed that the machine will instantly respond by simply placing the pointer on the maximum point of the dial. Combined with these two points is a third, which allows the welding of the thinnest sheet metal the arc is capable of handling.

The operating qualities obtained from these new features are: either short or long arc; high open circuit voltage for long arc; low open circuit voltage for short arc—at the will of the operator.

Due to the close control mentioned above, Type "S" Wilson Welder is well adapted to overhead welding.

NEW ELECTRODE HOLDER—THE "EUREKA"

The Fibre Metal Products Co., Chester, Pa., designers and manufacturers since 1914 of Bowers' Welding helmets and hand shields, have recently placed on the market the Eureka Metallic Electrode Holder, embodying a new principle which permits the holding of electrode with great pressure and at the same time requires only a slight effort to release. It is claimed that this feature insures perfect electrical contact between the electrode and holder and eliminates current losses and overheating of jaws. The holder is splendidly adapted for overhead welding. It is designed for 1/8 to 1/4 inch diameter electrodes.

Because of its very thorough insulation, it is possible to lay the holder down in practically any manner; for example, on board ship or on steel structures, without causing electrical contact.

The Fibre-Metal Products Co. also manufacturers the Vulcan Carbon Electrode Holder, designed for heavy duty carbon arc welding. It is made in 200, 400 and 600 ampere sizes for 1/2", 3/4" and 1-inch diameter electrodes. An outstanding feature of this holder is the fact that it will not overheat. It is also easily manipulated.

NEW WELDING HAND SHIELD

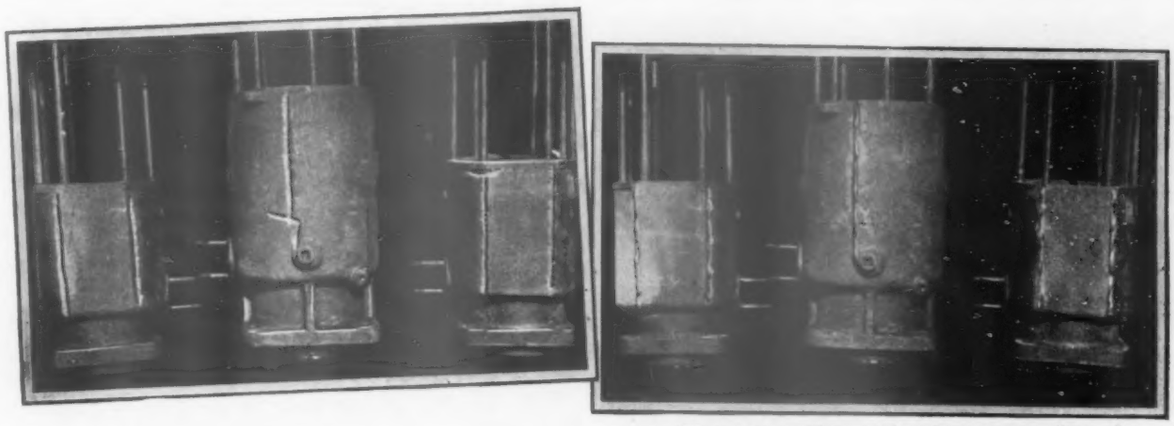
A new welding hand shield, called the Model O, has recently been announced by the Chicago Eye Shield Company, Chicago, Illinois, manufacturers of a complete line of eye protection devices. A strong feature of the new shield, which is shown clearly in the accompanying illustration, is the inside flange. This fits up and under the chin affording a proper rest to assure

Cesco Model "O" Hand Shield.

the shield being held in the prescribed position at all times, in addition to providing absolute neck protection. In a circular describing this shield it is pointed out that a correct adjustment of the shield used has a lot to do with securing high production of first class work with a minimum amount of effort. It is also pointed out that this new hand shield is light in weight and well ventilated so as to be comfortable; it is made throughout of specially vulcanized fibre. Essentialite lenses are standard equipment in this shield.

TOBIN BRONZE WELDING

Repairs 3 cracked water jackets in ninety minutes



This entire welding job (one large water jacket and two small ones) required 2½ lbs. Tobin Bronze, 20 cu. ft. oxygen and 20 cu. ft. acetylene.

TOBIN Bronze Welding by the oxy-acetylene process saved time and money on this job. These cylinder water jackets were cracked by freezing. The large one, taken from a 75 H.P. caterpillar tractor, had an 18″ crack. The smaller ones, from 60 H.P. tractors, had cracks averaging 12″ long.

In every case, the cracks were beveled to within 1/16″ of the thickness of the metal and Tobin Bronze Welded without preheating. The entire job was completed in an hour and a half.

Because of the low temperature required, 1650° F., Tobin Bronze Welding usually eliminates preheating, and minimizes distortion and metal shrinkage, thus making it possible to control the alignment. Tobin Bronze permeates the cast iron and knits the broken parts together in a permanent bond stronger than the casting itself. Tobin Bronze welds in cast iron, properly made, cannot break at the weld.

Many manufacturers who have proved the value of Tobin Bronze Welding in repair work are now using it to save time and money, or to improve quality, in their manufacturing operations.

Tobin Bronze Welding Rods may be obtained from distributors of welding equipment and supplies. Look for the trade-mark Tobin Bronze—it is stamped in every rod.

THE AMERICAN BRASS COMPANY
GENERAL OFFICES: WATERBURY, CONNECTICUT
Offices and Agencies in Principal Cities
Canadian Mill: ANACONDA AMERICAN BRASS LIMITED, New Toronto, Ont

TOBIN BRONZE
Reg. U. S. Pat. Off.
WELDING RODS

EXCLUSIVELY AN ANACONDA PRODUCT

CENTRAL STEEL AND WIRE OPENS WAREHOUSE AT DAYTON

The Central Steel and Wire Company, Chicago, Illinois, has recently opened a new warehouse in Dayton, Ohio, on East Monument Avenue Extended, which will make possible a much quicker delivery service to customers in the Dayton district. The new warehouse is stocked with a full line of wire and hot and cold rolled steels in addition to a complete stock of the well known "Swedox" line of welding wire, rods and electrodes. The equipment of shears and other necessary machinery for complete warehouse facilities has been installed. Deliveries throughout the Dayton district will, for the most part, be made by truck. Mr. R. C. Smith will be in charge of the Dayton warehouse as district manager and will be assisted by three salesmen working out of that office. The Central Steel and Wire Company now has three warehouses, the main one being in connection with the general offics at Chicago and the second one the Detroit warehouse which was established some time ago.

CARBON SALES DIVISION OF NATIONAL CARBON CO., INC., ANNOUNCES THE OPENING OF FOUR NEW BRANCH SALES OFFICES

The Carbon Sales Division of National Carbon Co., Inc., with general sales headquarters at Cleveland, Ohio, has announced the opening on January 3, 1928, of branch sales offices to be located at the present brush service plants of the company in New York City, Chicago, Ill., Pittsburgh, Pa., and Birmingham, Ala. The addresses of the newly established branch sales offices are as follows: 357 West 36th St., New York, N. Y.; 551 West Monroe St., Chicago, Ill.; Arrott Power Bldg., No. 3, Barker Pl., Pittsburgh, Pa., and 1824 9th Ave., North, Birmingham, Ala. Complete sales and service organizations have been established at each office and the customers of the company have been requested to address all orders and inquiries for carbon brushes and the other carbon specialties to the nearest Branch Sales Office.

The Brush Service Plants of the company have been in successful operation for a number of years and plans have been made to increase the manufacturing facilities of these plants. This material increase in both the sales and service facilities of the Carbon Sales Division has been brought about in recognition of the increased demand for its products in the industrial centers of the country.

Mr. E. A. Williford, manager of the Carbon Sales Division, Cleveland, Ohio, announces the following appointments:

Mr. J. A. Hammond, assistant manager in charge of Carbon Brush and Specialty Sales. Mr. Hammond will be located at the headquarters office at Cleveland, Ohio.

Mr. E. R. Geib, assistant manager in charge of sales of illuminating carbons. Mr. Geib will be located at the headquarters office in Cleveland, Ohio.

Mr. E. C. Friday, district manager in charge of the branch office at New York City.

Mr. J. L. Green, district manager in charge of the branch office at Chicago, Ill.

Mr. V. J. Nolan, district manager in charge of the branch office at Pittsburgh, Pa.

Mr. J. B. Collins, sales engineer in charge of the branch office at Birmingham, Ala.

WILSON APPOINTMENTS

Wilson Welder & Metals Co., Inc., Hoboken, N. J., announce the following representation:

Welding Machines

Joseph T. Ryerson & Son, Inc., with offices at Chicago, Ill.; Jersey City, N. J.; Buffalo, N. Y.; Pittsburgh, Pa.; Cleveland, Ohio; Detroit, Mich.; Cincinnati, Ohio; St. Louis, Mo.; Houston, Texas; Boston, Mass.

Oliver H. Van Horn Co., Inc. New Orleans, La.

Smith Booth Usher Co., Los Angeles and San Francisco, Cal.

Welding Wire

Austin-Hastings Co., Inc., Boston, Mass.

Oliver H. Van Horn Co., Inc., New Orleans, La.

Smith Booth Usher Co., Los Angeles and San Francisco, Cal.

J. C. Cristopher, Jacksonville, Fla.

Peter A. Frasse & Co., Inc., New York, N. Y.; Hartford, Conn.; Buffalo, N. Y.; Philadelphia, Pa.

General Engineering Co. Casper, Wyo.

North Coast Electric Co., Seattle, Wash.; Tacoma, Wash.; Portland, Ore.

George A. Post Co., Inc., New York N. Y.

Steel Sales Corp. Chicago, Ill.

Sligo Iron Store Co., St. Louis, Mo.

Chas. A. Strelinger Co., Detroit, Mich.

Welding Engineering Co., Bartlesville, Okla.

Williams & Co., Inc., Pittsburgh, Pa.

Welding Products Co., Birmingham, Ala.

NEWS OF THE WELDING TRADE

J. F. Lincoln, vice-president of the Lincoln Electric Company, will speak on "Methods of Redesign of Cast and Riveted Structures to Obtain the Economies Possible with Arc Welding" at a local meeting of the A. S. M. E. this month at Worcester, Mass.

The Detroit office of the Swift Electric Welder Company, manufacturers of resistance welding equipment, has been removed from Fort Street and Mt. Elliott Avenue, Detroit, to the Boulevard Temple Building, at West Grand Boulevard and Twelfth Street.

The Air Reduction Company, Inc., New York City, has acquired the assets and business of the Carolina Standard Gas Products Company, with an oxygen plant at Charlotte, North Carolina. The Air Reduction Sales Company now has the production and distribution facilities of thirty-six oxygen plants and twenty acetylene plants. These, with warehouses, give the company a total of 110 distributing points for oxy-acetylene gases, equipment and supplies.

Standard Steel and Wire Co., Greenburg, Pa., have increased the capacity of their mills at Boliver, Pa., the installation of new machinery now permitting the production of five hundred tons of welding wire a month. These mills are devoted exclusively to the production of welding wire, from raw material to finished product.

Having discontinued its office at Houston, Texas, the Graver Corporation of East Chicago, Indiana, has opened a Texas office in Fort Worth. The new address is 201 Petroleum Building.

The firm of Hannan and Julian, one of the leading commercial welding shops in the Chicago district, has recently added to its equipment by the purchase of one of the new style gas engine driven Westinghouse electric arc welding generator sets.

The Lincoln Electric Company, Cleveland, Ohio, announces the transfer of Mr. John Van Horne from Atlanta to Moline, Illinois, where he will be located at 514½ Fifteenth Street, and will operate under the direction of Mr. R. D. Malm, western manager at Chicago.

It is reported that the Linde Air Products Company, 30 East Forty-second Street, New York City, is planning to construct

"STANDARD"
Welding Wire
GAS AND ELECTRIC

for sound permanent welds : : lower costs
Our costs are considerably under those of large industrial centers; ours is a one-profit wire sold direct to user from our own mills exclusively devoted to making of welding wire from raw material to finished product—hence our extremely low prices for wire that is definitely superior. Adopted exclusively by many large users.
Prices on request.

A grade for each type of work—send for samples. Standard Steel & Wire Co., Greensburg, Pa. (Mills at Bolivar, Pa.)

a new oxygen plant at Portsmouth, Ohio. The estimated cost of the new plant with equipment is over $200,000.

Professor F. B. Thomson, a prominent member of the Institution of Welding Engineers of Great Britain and a frequent contributor to their programs, has recently been elected president of that organization.

G. J. Becker, formerly of the Chicago office of the Air Reduction Sales Company, was recently transferred to the Cleveland office as assistant district manager.

The Barnes Wire Fence Company, 10371 Northlawn Avenue, Detroit, Michigan, has just recently opened up a welding supply department which will feature Armco welding wire, Westinghouse direct current welding machines, Weldrite alternating current welding machines and Meco gas welding and cutting apparatus. Mr. R. C. Richards is head of the new department.

The Atlanta, Georgia, office of the Commercial Acetylene Supply Company, of New York City, has recently moved to new quarters at 708 Thrower Building, Atlanta, Georgia.

H. B. Pearson, of the Burdett Oxygen Company, Chicago, Illinois, spent the Christmas and New Year holiday season in Los Angeles, California, and has just recently returned to Chicago.

Attention is again called to the annual meeting and banquet of the Compressed Gas Manufacturers' Association, which will be held at the Hotel Astor, New York City, January 23rd.

A new structural steel building of all-welded construction, 35 by 135 feet, has just been erected as an addition to their former plant by the Prospect Boiler Company, Ward Street, New Brunswick, New Jersey.

Brooklyn. New York, is the location of the Supreme Welding and Repair Works which has just been incorporated with a capital of $10,000.

The K and K Welding and Auto Repair Company, 453 North Twelfth Street, Philadelphia, Pennsylvania, needs more room to take care of its business and has leased a building at 1306 Tallowhill Street.

Sellstrom Mfg. Co., manufacturers of welding goggles, helmets, respirators, etc., have moved to larger quarters at 344 North Ogden Avenue, Chicago, Illinois.

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address.

For Sale—Two Alternarc Welders, 220 volt, 60 cycle, 250 ampere. Both machines practically new. Price, $350.00 each. Wittenmeier Machinery Co., 850 N. Spaulding Ave., Chicago, Ill.

REBUILT ELECTRIC WELDERS
The following are a few items in our large stock:
200 amp. Lincoln A. C. motor drive
200 amp. Lincoln belt drive
200 amp. Lincoln D. C. motor drive
200 amp. Lincoln gasoline engine drive
Every machine guaranteed
GOODMAN ELECTRIC MACHINERY CO., 126 Green St., Newark, N. J.

FOR SALE

Thomson Spot Welder. Model No. 258-A-12. 20 K.W., 220 Volts, 60 Cycle, Single Phase A.C. Complete with starting switch. Excellent running condition. Address Box 139, care of The Welding Engineer.

For Sale—Monarch A. C. Welder used only 1 month, in good shape. $250.00.

For Sale—Zeus A.C. Welder, air cooled, bargain for immediate sale. $300.00.

For Sale—600/1000 ampere C&C arc welder, 5 panels, wonderful condition. $750.00.

Wanted—Belted type arc welder in good condition. Must be cheap. Write fully. Address Box 140, care of The Welding Engineer.

FOR SALE

PATENT RIGHTS IN THE FOLLOWING COUNTRIES: Canada, England, France, Argentine Republic, covering the latest improved alternating current electric arc welding machines. Address, N.A.S. care of The Welding Engineer.

FOR SALE

Acetylene Generator
500 Cubic Foot Oxweld
In good condition
HOWELL, FIELD & GODDARD, Inc.
Review Avenue, Long Island City

Wanted—Experienced final inspector of high grade complicated riveted and welded steel plate construction. Must be capable of checking dimensions against drawings and have necessary experience to competently judge quality of workmanship. Apply by letter, stating age and qualifications. Plant located in Northwestern Pennsylvania. Address Box 141, care of The Welding Engineer.

OXYGEN PLANT OPERATOR

Oxygen Plant in Venezuela, South America, offers permanent employment to experienced oxygen plant operator who thoroughly understands Messer plant and is capable of making necessary repairs to column. Will pay transportation to Venezuela and give board and lodging and good salary to right man. For complete information write or wire E. C. Caluwaert, 2633 4th St. S. E., Minneapolis, Minn.

Position Wanted—Gas and electric welder with 12 years experience on general welding. At present employed. Desires change. Prefers airplane work. Address Box 142, care The Welding Engineer.

WISSCO GRADE NO. 2 SPECIAL. PROCESSED ELECTRODES
Developed for particular consumers; i. e. Railroads, Shipyards, Boiler Makers, etc., for use on general repair work.

NO RIVETS--NO FITTINGS ONLY WISSCO WELDS ON THIS LARGE TANK AND PIPE LINE

An ice plant with a capacity of 500 tons has been constructed for the Canadian Government at Toronto, by the Carbondale Absorption Machine Co. Ltd., of Montreal.

The ice tank is 70′ by 32′ by 5.5′, of ¼″ plate. No rivets were used and no standard tees were employed as fittings; the entire job, including all cross lines from the main line, was electrically welded by the Thompson Welding Co., Limited, of Toronto, with Wissco No. 2 Special Processed Electrodes. A pressure of 180 pounds is required in the ammonia line, and the welds were tested to stand a pressure of 300 pounds.

Each grade of Wissco Welding Wire is composed of special analysis, especially processed wire produced for a certain type of welding.

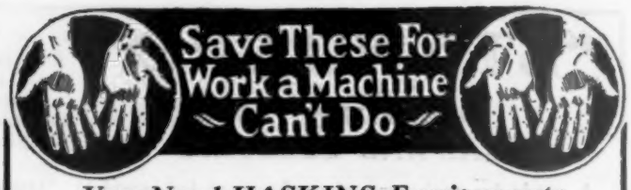
All Wissco Welding Wire is tested for chemical, physical and welding properties before being passed. Uniformity and proved welding ability are thereby insured.

WICKWIRE SPENCER STEEL COMPANY
41 EAST FORTY-SECOND STREET
NEW YORK CITY

Wickwire Spencer Steel Co.,
Dept. 1-WE, 41 East 42nd St., New York City.
Please send me your booklet "Wissco Welding Wire."

Name ..... Address .....

WICKWIRE SPENCER PRODUCTS



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For slotting before welding and for grinding welded points. HASKINS flexible shaft equipments pay for themselves by cutting your production costs and increasing efficiency. That's why they are so popular with production men everywhere.

Type H5 shown is recommended for general welding grinding. Has a ¼ H. P. motor; multiple speed Timken roller bearing countershaft with speeds of 875, 1,300, 2,350 and 3,500 R. P. M.; No. 5 ball bearing spindle; ⅜ inch x 5 feet flexible shaft; switch mounted on swivel plate; and spindle rest on countershaft.

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Portable Flexible Shaft Machinery
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WHARTON

Standard Seamless Steel Cylinders

for—

OXYGEN
HYDROGEN
LIQUEFIED PETROLEUM GAS

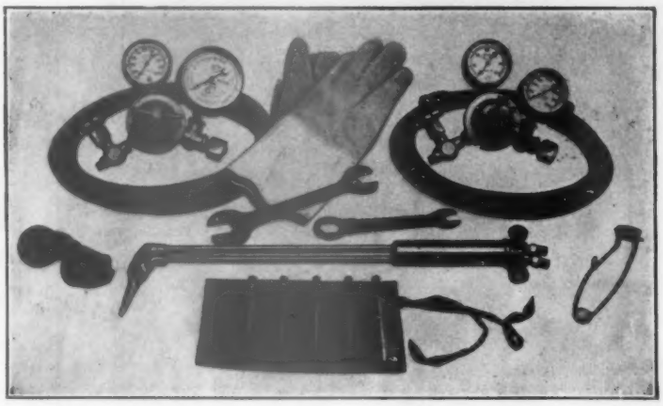
Interstate Commerce Commission Specifications

William Wharton Jr. & Co., Inc., Easton, Pa.
Cylinder Sales Office: 110 E. 42nd St., New York

Better Welding at Less Cost

from the Torch Which Cannot Leak

We have perfected the K-G torch by using only one seat in fitting the tip to the torch head. With this type of construction all wear can be taken up by a simple tightening of the tip, and a new tip is guaranteed to seat perfectly, no matter how long the torch has been in use.



These Dealers Sell K-G Torches:

Weldit Acetylene Co., 638 Bagley Ave., Detroit, Mich.
A. G. Sprague, 276 Davidson Ave., Perth Amboy, N. J.
Sight Feed Generator Co., West Alexandria, Ohio.
Welders Service Co., 229 Second Ave., Pittsburgh, Pa.
Passaic-Bergen Welding Works, 650 Main Ave., Clifton, N. J.
Passaic-Bergen Welding Works, 356 Fair St., Paterson, N. J.
Sutton-Garten Co., 217 W. 10th St., Indianapolis, Ind.
The Service Welding & Supply Co., 509 N. Park St., Columbus, Ohio.
The J. L. White Company, 16 Brown St., Waterbury, Conn.
Chicago Grinding & Machine Co., 2117 Tilden St., Chicago, Ill.
Motor Accessories Co., 1041 Hamilton St., Allentown, Pa.
Harry P. Winslow, 35 Vinton St., Worcester, Mass.
Wisconsin Motor Parts Co., 2446 Prairie Ave., Chicago, Ill.
Welders Supply Co., 700 McCulloch St., Baltimore, Md.
J. W. Evans Sons, 95 Brook St., Thompkinsville, Staten Island, N. Y.
Albany Welding & Boiler Works, 40 Madison Ave., Albany, N. Y.
Rocky Mountain Welders Supply Co., Denver, Colo.
H. Harrison Kress, 1718 Sansom St., Philadelphia, Pa.
Welding & Supplies Co., 3445 Parthenais St., Montreal, Can.
Welding & Supplies Co., Toronto, Can.
E. Brass Auto Supply Co., 307 Burnet St., New Brunswick, N. J.

K-G WELDING & CUTTING CO., INC.
515 W. 29th St.
New York City

K-G

Steel Sales Welding Rods

A Welding Rod for Every Job

Gas NORWELD Welding

Norweld, one of our leading rods, is a copper coated, low carbon soft wire for acetylene welding; uniform in quality; recommended for welding of wrought iron, steel, tanks, boiler plate, sheets, angles, flues, etc., where higher tensile strength is required.

Other rods carried in our Chicago stock for immediate shipment are:

Wilson Color-tipt	E†	Elecweld special	E
Norweld Special	A*	Elecweld	E
Norweld	A	Steelweld	E
Castweld	A	Vanadweld	A&E
Bronzeweld	A	Hicarweld	A&E
Nickelweld	A&E	High Manganese	A&E

*Acetylene †Electric

Write for The Welder's Guide, a Practical Book on Welding

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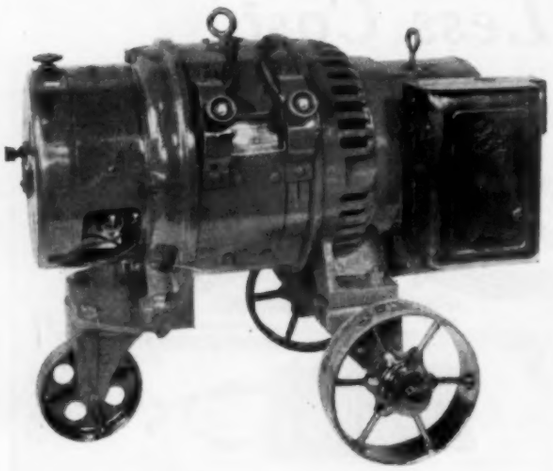
Steel, Monel Metal, Nickel, Brass, Copper, Copperweld, Nickel Silver, Phosphor Bronze, Nickel Zinc.



A Welder So Different
It Merits Investigation

No Exciter—No External Stabilizer—No Rheostat
—One Control—

Arc Flexibility Hitherto Unapproached
Welding Range Never Before Equaled

Lowest First Cost
Lowest Operating Cost

EQUIPMENT-SUPPLIES FUZON WELDING & CUTTING

FUSION WELDING CORPORATION
Engineers — Manufacturers — Merchants
103RD STREET AND TORRENCE AVENUE, CHICAGO

You Can Do It Better With TORCHWELD

TORCHWELD designs created new demands in the gas welding and cutting equipment field. Their success is proof of the soundness of Torchweld fundamental design, the fineness of their thoroughgoing construction, their safety, their economy and their dependability in operation.

If you have not tried Torchweld apparatus in your plant, you owe it to yourself to do so.

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Best Results

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TORCHWELD EQUIPMENT COMPANY
224 N. Carpenter St. CHICAGO

Uniform Quality Assured

WELDERS who use Commercial Acetylene soon learn that every cylinder contains the same pure gas.

Your torch can tell the difference!

COMMERCIAL ACETYLENE
Means pure acetylene.

COMMERCIAL SERVICE
Means prompt service.

No matter what your gas requirements may be you will be interested in our sales plan. Ask our nearest office to tell you about it.

Supplied in the following size cylinders:

10x30-in. size	- -	125 cu. ft. cap.
12x36-in. size	- -	225 cu. ft. cap.
12x44-in. size	- -	275 cu. ft. cap.

Commercial Acetylene Supply Company, Inc.

General Office: 71 Broadway
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BRANCHES:

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683 Atlantic Ave.
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You can prove the value of Page-Armco Welding Wire and Electrodes for yourself and your own job.

Careful tests will show you that this carefully processed and thoroughly shop tested wire gives better welding results. What is more, it costs less to use when you figure complete welding costs of time and material. Workmen will tell you Page-Armco Welding Wire is easier to use. It will pay you to investigate.

PAGE STEEL *and* WIRE COMPANY
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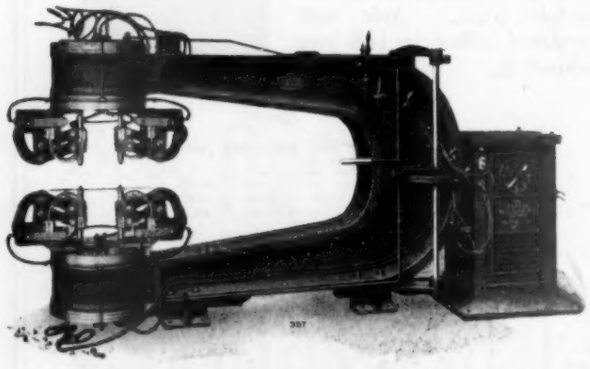

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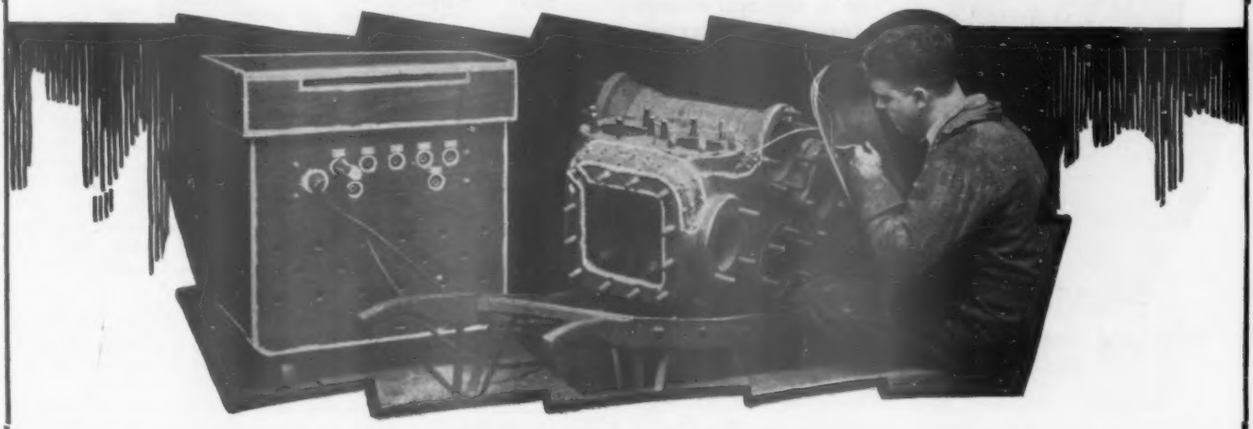

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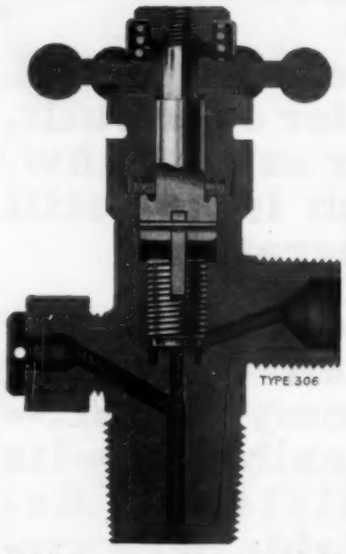

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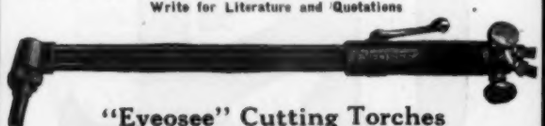

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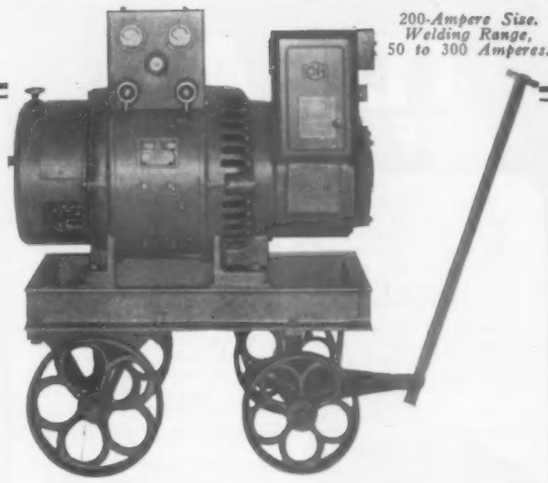

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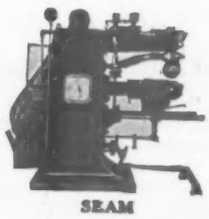

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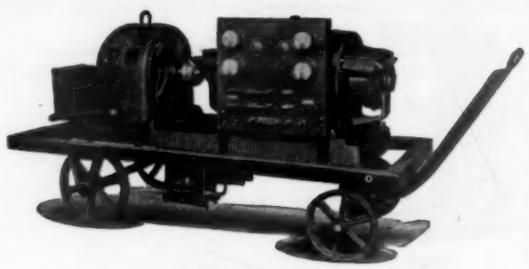

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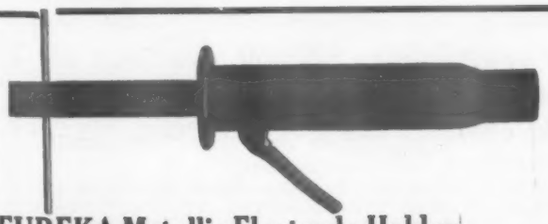

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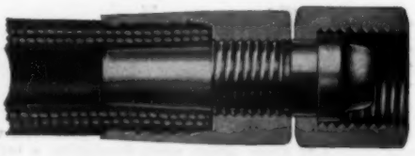

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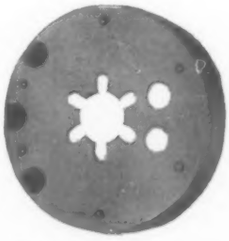

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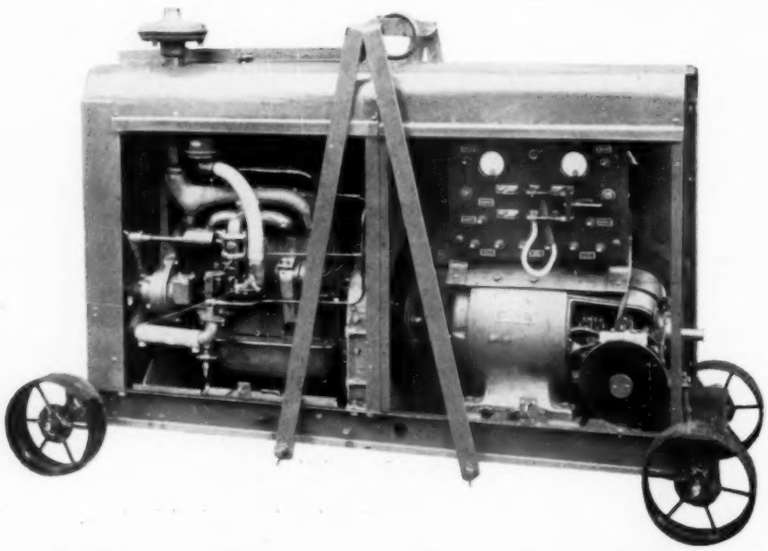

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